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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 9359, 9360, 9496, 9510, 9511, 9513, 9668, 9816, 9845, and 10997.

9294 (AERE-R-5878) DETERMINATION OF OXYGEN IN SILICON NITRIDE BY INERT GAS FUSION. Griffin, I. M.; Mead, A. P. (Atomic Energy Research Establishment, Harwell (England)). Aug. 1968. 9p. Dep. CFSTI. UK 2s. 6d.

In the method described the sample, encapsulated in a platinum tube, is reacted with carbon first at 1500°C and then at 2100°C, the carbon monoxide formed at each temperature being removed in a stream of high purity helium. After oxidation of the carbon monoxide with copper oxide the carbon dioxide is frozen out in a multiloop trap and finally measured in an open-well capillary manometer. The two heating temperatures distinguish between "free" or adsorbed oxygen, and combined oxygen (probably present as SiO_2). (auth) (UK)

9295 (CEA-R-3442) DETECTION OF α PARTICLES USING SEMICONDUCTORS. APPLICATION TO THE CONTROL OF PLUTONIUM EXTRACTION. Tanguy, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1968. 203p. (in French). Dep.

Thesis. Submitted to Univ., Paris.

A study was made of α particles produced by thick sources, using either diffused-junction or surface-barrier semiconductor detectors for continuously controlling the plutonium extraction process. For this, an apparatus is described in which the solutions to be analyzed flow in contact with the detector protected by a thin mica membrane. A precise recording of the spectra is given and this allows the separation of two or more α emitters present in the same solution. This method was applied to the measurement of ^{239}Pu in the presence of ^{241}Am with an accuracy of ±5%. The detection of plutonium in solutions of $\beta-\gamma$ emitting fission products is also considered. Pile-up is reduced by using a fast amplification chain associated with totally depleted thin detectors. Under these conditions a few mg of ^{239}Pu can be detected in solutions of fission products having an activity of 100 curies/liter. A method is given for discriminating α and β particles, it is based on the difference in the collection times for the charges liberated by these particles in the detector. (auth)

9296 (LA-4008) MEASUREMENT OF CARBON GRADIENT IN STAINLESS STEEL BY ^3He ACTIVATION AND AUTORADIOGRAPHY. Parker, Jack L.; Holm, Dale M. (Los Alamos Scientific Lab., N. Mex.). Apr. 1968. Contract W-7405-eng-36. 9p. Dep. CFSTI.

A method combining activation by ^3He irradiation with autoradiographic techniques was demonstrated to give good measurements of both carbon concentration and carbon gradients in stainless steel. Carbon in the surface of the sample is first activated by the $^{12}C(^3He,^4He)^{11}C$ reaction (^3He energy of ≈6.5 MeV). Autoradiographs of the activated surface are then made, the exposure being mainly by the positrons from the decay of the ^{11}C ($^{11}C^{20.4min}{}^{11}B + \beta^+ + \nu$). Densitometric analysis of the autoradiographs together with a measurement of the ^{11}C activity induced in the sample and a knowledge of reaction cross section, particle range, and other parameters are used in the computations. The technique is applicable to the determination of carbon distributions in matrices with $Z \geq 25$. (auth)

9297 (MLM-1575(tr)) DETERMINATION OF FREE ACIDITY IN CONCENTRATED AQUEOUS SOLUTIONS OF PLUTONIUM(IV). Damien, Nicole; Cauchetier, Philippe. Translated for Mound Lab., Miamisburg, Ohio from Anal. Chim. Acta, 41: 483-95(1968). 26p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 27576.

9298 (NBS-TN-467(Pt.1 and 2)) ACTIVATION ANALYSIS: A BIBLIOGRAPHY. Lutz, G. J.; Boreni, R. J.; Maddock, R. S.; Meinke, W. W. (eds.) (National Bureau of Standards, [Boulder, Colo.] Inst. for Materials Research). Sept. 1968. 715p. GPO $6.50.

References to activation analysis in the open literature are published from a computer readout. The first part of the two-part series contains more than 6000 references numbered according to their accession to the system. The second part contains an author index and three additional indexes for "element determined," "matrix analyzed," and "technique used." Part 1 will be updated periodically by addenda containing new references while Part 2 will be periodically revised and replaced by new pages, which include cross references to the new accessions. (auth)

9299 (ORNL-4343) ANALYTICAL CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1968. Raaen, Helen P. (comp. and ed.) (Oak Ridge National Lab., Tenn.). Dec. 1968. Contract W-7405-eng-26. 149p. Dep. CFSTI.

Twelve sections are included; a separate abstract was prepared for each. (P.C.H.)

For abstracts of individual papers see: 9300-9307, 9355-9357, and 9513.

9300 (ORNL-4343, pp 1-10) ANALYTICAL INSTRUMENTATION. (Oak Ridge National Lab., Tenn.).

BIOCHEMISTRY—polarographic survey of compounds in
CHEMICAL ANALYSIS—instrumentation for
CURRENT INTEGRATORS—design of operational-amplifier
INSTRUMENTS—development for use in chemical analysis
POLAROGRAPHS—performance of, electrical and electrochemical tests on
—performance and resolution of controlled-potential dc, circuit modifications for
POTENTIOMETRIC ANALYSIS—equipment for end-point detection in bipotentiometric titrations
ZIRCONIUM CHLORIDES—polarographic behavior in acetonitrile and dimethyl sulfoxide (P.C.H.)

9301 (ORNL-4343, pp 11-23) ANALYTICAL METHODOLOGY. (Oak Ridge National Lab., Tenn.).

ACTINIDES—separation of californium from, method for
AMERICIUM—determination by controlled-potential coulometry—determination by redox titrimetry
AMERICIUM-241—purification of, ion exchange and precipitation method for
AMERICIUM-243—purification of, ion exchange and precipitation method for
ANTIMONY OXIDES—sorptive properties for sodium in presence of copper and manganese in acid solutions
ATMOSPHERE—contamination of, over Clinton, Tennessee
CADMIUM—content in atmosphere over Clinton, Tennessee

CALIFORNIUM—separation from actinides and fission products, method for
CHROMATOGRAPHY—laboratory for gas, remodeled
—developments in aqueous-injection gas, for analysis of aqueous solutions
COPPER—separation of sodium from, in acid solutions by column chromatography using antimony pentoxide
CYCLOHEXANE, UNDECAFLUORO(TRIFLUOROMETHYL)-—determination in methane using gas chromatography
ETHYLENE, TETRAFLUORO-, POLYMERS—properties for use as adsorbent in partition and reversed-phase chromatography
FISSION PRODUCTS—separation of californium from, method for
FLUORIDES—content in atmosphere over Clinton, Tennessee
GASES—sampling in sealed metal tubes, device for
HALIDES—content in atmosphere over Clinton, Tennessee
HYDROCARBONS—content in atmosphere over Clinton, Tennessee
HYDROCHLORIC ACID—concentration of chlorine-36-labeled, by controlled dehydration
MANGANESE—separation of sodium from, in acid solutions by column chromatography using antimony pentoxide
METHANE—analysis for undecafluoro(trifluoromethyl)cyclohexane using gas chromatography
NEPTUNIUM—determination of, voltammetric method for
NITROGEN OXIDES NO_2—content in atmosphere over Clinton, Tennessee
ORGANIC COMPOUNDS—purification by preparative gas chromatography
—separation from water, evaluation of lipophilic polystyrene adsorption resins for
PHOSPHORIC ACID, ALKYL ESTERS—separation from each other and TBP by gas chromatography
PHOSPHORIC ACID, TRIBUTYL ESTER—separation from alkyl esters of phosphoric acid by gas chromatography
PLUTONIUM—determination of micro and semimicro amounts of, titrimetric method for
—determination of, voltammetric method for
RESINS—evaluation of lipophilic polystyrene adsorption, for separation of organic compounds from water
SAMPLING—device for gas, in sealed metal tubes
SMOKES—analysis for components in tobacco, by thin-layer chromatography
SODIUM—separation from copper and manganese in acid solutions by column chromatography using antimony pentoxide
STEROIDS—determination in urine by thin-layer chromatography, equipment and materials for
STYRENE POLYMERS—evaluation of lipophilic adsorption resins of, for separation of organic compounds from water
SULFUR—content in atmosphere over Clinton, Tennessee
URANIUM—polarographic behavior of, in hydrofluoric acid with vertical-orifice Teflon dropping-mercury electrode
URINE—analysis for urine by thin-layer chromatography, equipment and materials for
WATER—analysis of, developments in aqueous-injection gas chromatography method for
—separation of organic compounds from, evaluation of lipophilic polystyrene adsorption resins for (P.C.H.)

9302 (ORNL-4343, pp 23-33) ANALYTICAL CHEMISTRY FOR REACTOR PROJECTS. (Oak Ridge National Lab., Tenn.).

BERYLLIUM COUPLES—electric potentials in molten beryllium fluoride–lithium fluoride–zirconium fluoride at 500°C
BERYLLIUM FLUORIDES—BeF_2–LiF–ZrF_4, reactions of molten, with chromium, voltammetric studies on electrochemical reduction
CHROMIUM—reduction by molten beryllium fluoride–lithium fluoride–zirconium fluoride, voltammetric studies on electrochemical
—spectra of di- and trivalent, in molten fluoride salts
CHROMIUM COUPLES—electric potentials in molten beryllium fluoride–lithium fluoride–zirconium fluoride at 500°C
COPPER—spectra in molten lithium fluoride–potassium fluoride–sodium fluoride
HELIUM—analysis of MSRE, for hydrocarbons, equipment and method for
HYDROCARBONS—determination in MSRE helium, equipment and method for
HYDROFLUORIC ACID—separation from molten lithium fluoride–potassium fluoride–sodium fluoride salts, method for
IRON—spectra of divalent, in molten fluoride salts
IRON COUPLES—electric potentials in molten beryllium fluoride–lithium fluoride–zirconium fluoride at 500°C
LITHIUM FLUORIDES—BeF_2–LiF–ZrF_4, reactions of molten, with chromium, voltammetric studies on electrochemical reduction
—KCl–LiCl–NaCl, separation of hydrofluoric acid and silicon tetrafluoride from, method for
MOLTEN SALT REACTOR EXPERIMENT—fuel analysis for oxides by hydrofluorination
—fuel analysis for uranium(III), hydrogen-reduction method for
MOLYBDENUM FLUORIDES—spectra in molten lithium beryllium fluoride
NICKEL—spectra of divalent, in molten fluoride salts
NICKEL COUPLES—electric potentials in molten beryllium fluoride–lithium fluoride–zirconium fluoride at 500°C
OXIDES—determination in MSRE salts by hydrofluorination
POTASSIUM FLUORIDES—KCl–LiCl–NaCl, separation of hydrofluoric acid and silicon tetrafluoride from, method for
REACTOR FUELS—analysis of molten salt, for oxides by hydrofluorination
—analysis of molten salt, for uranium(III), hydrogen-reduction method for
SILICON FLUORIDES—separation from molten lithium fluoride–potassium fluoride–sodium fluoride salts, method for
SODIUM FLUORIDES—KCl–LiCl–NaCl, separation of hydrofluoric acid and silicon tetrafluoride from, method for
SPECTROPHOTOMETRY—facility for, of radioactive samples
URANIUM—determination in radioactive MSRE fuel, hydrogen-reduction method for
—spectra of penta- and hexavalent, in molten lithium beryllium fluorides
ZIRCONIUM COUPLES—electric potentials in molten beryllium fluoride–lithium fluoride–zirconium fluoride at 500°C
ZIRCONIUM FLUORIDES—BeF_2–LiF–ZrF_4, reactions of molten, with chromium, voltammetric studies on electrochemical reduction (P.C.H.)

9303 (ORNL-4343, pp 33-52) ANALYTICAL BIOCHEMISTRY. (Oak Ridge National Lab., Tenn.).

AMINO ACIDS—separation of carbon-14-labeled, from assay mixtures by cation exchange using D2EHPA
—determination of trace amounts of, by isotope dilution and aminoacylation
ASPARAGINASE—determination of, method for
CHROMATOGRAPHY—ligand-exchange, on copper-loaded Chelex resin columns, principles of
NUCLEIC ACID, RIBO-—determination of transfer, fractional factorial method for optimizing conditions for
—analysis of transfer, computer processing of liquid scintillation counting data in
—aminoacylation of transfer, kinetics of
—analysis of transfer, for impurities, spectrophotometric methods for
—electrophoresis of
NUCLEOSIDES—separation by ligand-exchange chromatography
RESINS—sorptive properties of copper-loaded Chelex, in ligand-exchange chromatography, principles of
URINE—analysis for constituents by anion exchange chromatography and spectroscopy
—hydrolysis of, anion exchange chromatography of products of
—fractionation of human, by gel chromatography (P.C.H.)

9304 (ORNL-4343, pp 53-6) X-RAY AND OPTICAL SPECTROCHEMISTRY. (Oak Ridge National Lab., Tenn.).

A code has been written for converting x-ray diffraction data to lattice parameters. A technique has been developed for determining sulfur-to-phosphorus ratios in small organic samples with the electron probe. The optical and mechanical design of a beam splitter for calibrating spectrographic film has been optimized, and the best conditions for its use were determined for different types of spectrographs. Preconcentration procedures were devised for traces of rare-earth elements in bismuth, cadmium in plutonium, and bismuth in LiF–BeF_2. In the electrodialysis—Mitchell–Scott procedure for determining trace elements in bone, the removal of phosphate was accelerated by use of a two-compartment electrodialysis cell. Recoveries and total process blanks were determined for numerous trace impurities. A procedure was developed for determining silicon in curium oxide. (auth)

9305 (ORNL-4343, pp 57-8) MASS SPECTROMETRY. (Oak Ridge National Lab., Tenn.).

A trace characterization analysis of ^{242}Pu ($t_{\frac{1}{2}} = 3.79 \times 10^5$ y) was conducted by use of the solution spark-source technique. Twenty-one general contaminants were found. The distribution of rare earth elements in different leaf and wood ash samples was also determined. The low-resolution mass spectrometer has been

used to record the spectra of a wide variety of organic compounds for identification or elucidation of structure and to accumulate reference spectra for known compounds. For samples of adequate size and purity, the mass spectrometry has been coordinated with NMR and ir spectrometry. Surface ionization studies showed that, in the presence of oxygen, the emission of UO_2^+ from tungsten filaments exhibits two maxima as the temperature is increased. The temperatures at which these maxima occur are very weakly dependent on the partial pressure of oxygen. Below ~1500°K, the evaporation energy of UO_2^+ is deduced to be 6.9 ± 0.4 eV. Between ~1500 and 2250°K, the effects of competing reactions hinder satisfactory interpretation of the data. A measurement of the ionization potential of Th has yielded a tentative value of 7.5 ± 0.3 eV. (P.C.H.)

9306 (ORNL-4343, pp 62-84) NUCLEAR AND RADIOCHEMISTRY. (Oak Ridge National Lab., Tenn.).

ACTINIDES—deposition from dimethyl sulfoxide, for use in alpha spectrometry, method for electro-
ACTIVATION ANALYSIS—equipment for, air-floating sphere for homogeneous neutron and photon irradiation with uneven flux
—effects of channeling in customary helium-3
ALKALI METALS—analysis for oxygen by 14-MeV neutron activation
ARSENIC-73—determination in presence of arsenic-72, -74, and -76, efficiency of beryllium-window lithium-activated germanium spectrometer for
BARIUM-133—decay of, efficiency of beryllium-window lithium-activated germanium spectrometer for studies on
—decay of, intensity of γ rays in
BARIUM-140—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
BIPYRIDINE—complexes with iron, radiation effects on stability of, in spectrophotometric determination of iron
BRAIN—analysis of phenothiazine-treated and subhuman primate, for copper and manganese by neutron activation and radiochemical separation
CALIFORNIUM-252—properties for use as neutron source in activation analysis
CARBON-14—scintillation counting of, effects of Triton X on efficiency of
CERIUM-141—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
CERIUM-144—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
CESIUM-137—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
—diffusion from reactor-fuel microspheres
CHERENKOV RADIATION—uses in chemical analysis
CHLORINE-38—gamma energy for, measurement of
COBALT-57—measurements on concentration of solutions of, interlaboratory comparison of
COPPER—determination in brain tissue of phenothiazine-treated subhuman primates by neutron activation and radiochemical separation
FLUORINE—determination in fluorspar ore by 14-MeV neutron activation
FLUORSPARS—analysis for fluorine by 14-MeV neutron activation
GAMMA RADIATION—effects on radiation-safeguard spray solutions
—effects on solubility of metals in mineral acids
—effects on spectrophotometric determination of iron using bipyridine, 1,10-phenanthroline, and thiocyanate
GAMMA SPECTROMETERS—efficiency of lithium-activated germanium diode
GOLD—solubility in γ-irradiated mineral acids
GRAPHITE—analysis for in-reactor fission product penetration in, γ spectrometric
HEAT EXCHANGERS—analysis of MSRE, for fission products by lithium-activated germanium γ spectrometry
HYDROCHLORIC ACID—solvent properties of γ-irradiated, for metals
INDIUM-116—gamma energy for, measurement of
IODINE-129—gamma spectrum of
IODINE-131—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
—diffusion from reactor-fuel microspheres
IODINE-132—determination in MSRE heat exchanger by lithium-activated germanium γ spectrometry
IRON—radiation effects on spectrophotometric determination of, using bipyridine, 1,10-phenanthroline, and thiocyanate, γ
LANTHANUM-140—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
LEAD-208—reactions (n,γ), thermal-neutron cross sections for
MANGANESE—determination in brain tissue of phenothiazine-treated subhuman primates by neutron activation and radiochemical separation
MOLYBDENUM-99—measurements on concentration of solutions of, interlaboratory comparison of
—determination in MSRE heat exchanger by lithium-activated germanium γ spectrometry
NEUTRONS, THERMAL—reactions (n,γ) with lead-208 and nickel-64, cross sections for
NICKEL-64—reactions (n,γ), thermal-neutron cross sections for
NIOBIUM—solubility in γ-irradiated mineral acids
NIOBIUM-95—determination in MSRE heat exchanger by lithium-activated germanium γ spectrometry
—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
NITRATES—radiolysis of, reactions of products formed by
NITRIC ACID—solvent properties of γ-irradiated, for metals
ORNL High-Flux Isotope Reactor—coolant analysis for radioisotopes by γ spectrometry
OXYGEN—determination in alkali and refractory metals by 14-MeV neutron activation
PERCHLORIC ACID—radiolysis of, reaction of products formed by
—solvent properties of γ-irradiated, for metals
1,10-PHENANTHROLINE—complexes with iron, radiation effects on stability of, in spectrophotometric determination of iron
PHENOTHIAZINE—effects on copper and manganese content in brain tissue in subhuman primates, activation analysis studies on
PHOSPHORIC ACID—solvent properties of γ-irradiated, for metals
PHOSPHORS—effects of Triton X on counting efficiency of weak-beta-emitting radioisotopes
PLATINUM—solubility in γ-irradiated mineral acids
RADIATION—effects on nitrates, reactions of products formed by
—effects on perchloric acid, reactions of products formed by
RADIOISOTOPES—analysis for impurities by isotope dilution and γ spectrometry
—determination in HFIR coolant water by γ spectrometry
REACTOR FUELS—diffusion of cesium-137 and iodine-131 from microspheres of
REFRACTORY MATERIALS—analysis for oxygen by 14-MeV neutron activation
RUTHENIUM-103—determination in MSRE heat exchanger by lithium-activated germanium γ spectrometry
—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
RUTHENIUM-106—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
SILVER—solubility in γ-irradiated mineral acids
SPRAYS—radiolysis of solutions of radiation-safeguard, γ
SULFURIC ACID—solvent properties of γ-irradiated, for metals
TANTALUM—solubility in γ-irradiated mineral acids
TECHNETIUM-99—measurements on concentration of solutions of metastable, interlaboratory comparison of
TELLURIUM-132—determination in MSRE heat exchanger by lithium-activated germanium γ spectrometry
—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric
THIOCYANATES—complexes with iron, radiation effects on stability of, in spectrophotometric determination of iron
TISSUES—analysis of brain, in phenothiazine-treated subhuman primate, for copper and manganese by neutron activation and radiochemical separation
TRITIUM—scintillation counting of, effects of Triton X on efficiency of
TUNGSTEN—solubility in γ-irradiated mineral acids
URANIUM-233—determination in MSRE fuel salt, improvements in delayed neutron counting method for
URANIUM-235—determination in MSRE fuel salt, improvements in delayed neutron counting method for
X-RAY SPECTROMETERS—efficiency of beryllium-window lithium-activated germanium, for measurement of low-intensity γ or x rays
ZIRCONIUM—solubility in γ-irradiated mineral acids
ZIRCONIUM-95—determination of in-reactor penetration of, into MSRE and pyrolytic graphite, γ spectrometric (P.C.H.)

9307 (ORNL-4343, pp 94-7) PROCESS ANALYSES. (Oak Ridge National Lab., Tenn.).

Research activities and developments in various laboratories

are reported. These include high-level alpha radiation laboratory, general analyses laboratory, general hot-analyses laboratory, and radioisotopes-radiochemistry laboratory. Developments in radiation control and safety and quality control are briefly discussed. (P.C.H.)

9308 (TRG-Report-1735) ANALYTICAL ASPECTS OF CHEMICAL STUDIES ON IRRADIATED OXIDE NUCLEAR FUELS. Sinclair, V. M. (United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group). Aug. 6, 1968. 23p. Dep. CFSTI. UK 5s. 0d.

Methods used for sampling and handling the fuels are discussed. The measurement of burnup by determination of radioactive and stable fission products is described, and possible errors in measurements for the Dounreay Fast Reactor are considered. Problems encountered in the determination of burnup from isotopic composition changes are also outlined. Work on the chemical nature of the fission products involved measurement of the oxygen potential of the irradiated fuel and identification of fission product inclusions. (UK)

9309 SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF FLUORIDE IN PLUTONIUM. Redding, P. L.; Yates, W. G.; Bishop, C. T.; Sellers, D. E. (Monsanto Research Corp., Miamisburg, Ohio). Anal. Lett., 1: 913-18 (1968). (MLM-1586(J)).

A simple and rapid spectrophotometric method for the determination of 10 to 70 μg of fluoride in up to 10 mg of plutonium fusing Eriochrome Cyanine R was developed. In this method interference from the plutonium is eliminated by reduction of this element to the tripositive oxidation state with mercaptoacetic acid. (auth)

9310 CHEMICAL AND IONIZATION INTERFERENCES IN THE ATOMIC ABSORPTION SPECTROPHOTOMETRIC MEASUREMENT OF SODIUM, POTASSIUM, RUBIDIUM, AND CESIUM. Sanui, Hisashi; Pace, Nello (Univ. of California, Berkeley). Anal. Biochem., 25: 330-46(Oct. 24, 1968).

Although chemical and ionization interferences significantly affect the atomic absorption signal of the alkali metals, suitable corrective measures permit accurate analysis of these elements. The observed interferences are affected in opposite ways by flame temperature, chemical depression of absorption produced by anions, and ionization enhancement produced by cations. Phosphate affects the cations in the order Na < K < Rb < Cs, with 20 mmoles phosphate depressing cesium absorbence approximately 40%. Conversely, ionization enhancement by cations is small in a propane-air flame and large in an acetylene-air flame; the effect on rubidium absorbence increases in the sequence Mg < Ca < Li < Na < K < Cs, with 20 mmoles cesium producing a two-fold increase in absorbence. This is in the order of decreasing ionization potentials, indicating a direct relationship between ionization potential degree of ionization, and enhancement produced. It was concluded that the propane-air flame is probably the most satisfactory for alkali metal analysis, especially for rubidium and cesium. Recovery studies on dialyzed and ashed rat liver microsomes and known controls demonstrated that addition of 15 mmoles lanthanum, to minimize anionic interferences, and addition of moderate concentrations of cesium, rubidium, or potassium, to minimize cationic enhancement, permit accurate and reliable measurement of the alkali metal cations in biological materials in the presence of potentially interfering cations and anions. (auth)

9311 INSTRUMENTAL ACTIVATION ANALYSIS FOR THE PRINCIPAL ELEMENTS IN METEORITES BY MEANS OF SHORT-LIVED ISOTOPES. Chayka, M. (Central Inst. for Physical Research, Budapest); Sabo, E.; Lavrukhina, A. K. Geochem. Int., (Engl. Transl.), 4: 892-902(1967).

Translated from Geokhimiya, No. 9, 1106-16(1967).

Attempts to determine Mg, Ni, Co, Al, Mn, Fe, and Si in both iron and silicate meteorites are described. A nondestructive neutron activation method utilizing (n,α) and (n,p) reactions was studied. Al was determined at the 10 ppM level in 5 mg samples. Si was determined in silicate meteorites; P interfered with this determination in iron meteorites. In iron meteorites, the interferences of Ni with the determination of Co amounted to ~10%. Ni was determined in iron meteorites but could not be detected in silicate meteorites. Mn was easily determined in silicate meteorites; it was also determined in iron meteorites with good accuracy in spite of a 90% correction due to $^{56}Fe(n,p)^{56}Mn$ interference. The determination of Mg depends critically on the Fe : Si : Mg : Al : Mn ratios; it could be determined in olivine but not in a chondrite. Fe could be determined only when Fe : Mn > 100. (auth)

9312 TRACE ANALYSIS OF ATOMIC ABSORPTION SPECTROPHOTOMETRY: A SEQUENTIAL MULTI-ELEMENT APPROACH BY SOLVENT EXTRACTION. Montford, B. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Can. Spectrosc., 13: 126-30(Nov. 1968).

The use of solvent extraction in conjunction with atomic absorption spectroscopy was investigated as a sensitive method of analysis. Six different chelating agents and six organic solvents were studied and compared. A sodium diethyldithiocarbamate (NaDDC-methyl isobutyl ketone (MIBK) system showed a 100-fold gain in sensitivities compared to aqueous solutions for Fe, Cu, Co, Cr, Mn, and Ni. The metals are pre-concentrated simultaneously and determined sequentially using a multielement hollow cathode lamp. A procedure is described for analysis in the concentration range 0 to 50 μg/l. Eight samples can be analyzed for six metals in 90 minutes. (auth)

9313 DETERMINATION OF IMPURITIES OF SOME ELEMENTS IN QUARTZ MATERIALS BY MEANS OF NEUTRON ACTIVATION ANALYSIS. Babaev, A.; Mamadzhanov, F. (Inst. of Physics and Tech., Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR, 11: No. 8, 13-16(1968). (In Russian).

Neutron activation analysis of piezoquartz materials was carried out with several specimens irradiated by fast neutrons in a thermal reactor channel. Irradiation for 3 and 5 minutes revealed the content of ^{116}Ir equal to 1.42×10^{-5} g and ^{28}Al equal to 1.61×10^{-6}. (R.V.J.)

9314 MEASUREMENT OF ^{228}Ra AND ^{228}Th IN SEA WATER. Moore, Willard S. (Columbia Univ., Palisades, N. Y.). J. Geophys. Res., 74: 694-704(Jan. 15, 1969).

The first measurements of ^{228}Ra in the ocean are reported, and the analytical methods of determining ^{228}Ra and ^{228}Th are discussed. Measurable excesses of both ^{228}Ra and ^{228}Th relative to the ^{232}Th exist in the ocean. ^{228}Ra should prove a valuable tracer for studies of water movements. Its 6.7-year half-life makes it applicable to processes with a time scale of 3 to 25 years. (auth)

9315 SPECTROPHOTOMETRIC DETERMINATION OF SCANDIUM WITH CHROMAZUROL S AND ZEPHIRAMINE. Horiuchi, Yoshizo; Nishida, Hiroshi (Iwate Univ., Morioka, Japan). Bunseki Kagaku, 17: 1486-91(Dec. 1968). (In Japanese).

The reaction of Chrome Azurol S (CAS) with scandium to form a bluish violet complex in the presence of zephiramine (benzyldimethyltetradecylammonium chloride) in a weakly acidic medium was applied to the determination of a small amount of scandium. CAS solution was added to the acidic solution containing scandium, and the pH was adjusted with 7% hexamine solution. After the addition of zephiramine solution, it was diluted, and the absorbence at 625 mμ was measured within 30 min against the reagent blank. The apparent molar absorptivity at 625 mμ was 1.37×10^5. Aluminum, gallium, phosphate, and fluoride interfered seriously. The yttrium and lanthanum complexes were decomposed in the presence of excess zephiramine. They did not interfere with the scandium determination. (auth)

9316 THE ISOTOPIC ANALYSIS OF IRON BY ATLAS MASS SPECTROMETER CH-4. Goto, Hidehiro; Suzuki, Shin; Kishimoto, Mokuyoshi; Yamamura, Yoshinobu; Nomura, Akira (Tohoku Univ., Sendai). Bunseki Kagaku, 17: 1509-12(Dec. 1968). (In Japanese).

In the isotopic analysis of iron by the double filament surface ionization method, ferric oxide is the most convenient chemical form as a sample because of the simplicity of its use in a chemical procedure. But the ion beam produced from this sample is very unstable. To overcome this difficulty, the effect of the addition of other oxides (supporting agents) to the sample was investigated in detail. Thorium oxide was found to be the best supporting agent among many oxides studied. The optimum mixing ratio of iron to thorium was found to be 4 to 1 on the molar basis. The effect of fractional distillation was not observed, and the differences in ionization in experimental time, and in the degree of filament consumption had no effect on the analytical results. This method has a considerably high accuracy and the relative standard deviation of the analytical result was 0.3 to 0.4%. (auth)

9317 SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM(IV) BY USING EXTRACTION OF ZIRCONIUM(IV)-ALIZARIN RED S COMPLEX WITH TRI-N-OCTYLAMMONIUM CHLOROACETATE. Ishibashi, Nobuhiko; Kohara, Hitoshi; Fukamachi, Kazumi (Kyushu Univ., Fukuoka). Bunseki Kagaku, 17: 1524-8(Dec. 1968). (In Japanese).

The extraction of the Alizarin Red S complex of zirconium (IV) with high molecular weight ammonium salt and the formation of polycomplexes in the organic phase were investigated to increase the sensitivity of spectrophotometric determination of zirconium (IV) with Alizarin Red S. The complex having 1 : 1 mole ratio of zirconium (IV) and Alizarin Red S was extracted into toluene containing tri-n-octylammonium chloroacetate, and the distribution

constant was determined. The polycomplex was formed by shaking the 1:1 complex in the organic phase with buffer solution of pH 4.1. The polycomplex formed by this procedure has an absorption maximum at 538 mμ, but has also an absorption at 550 to 600 mμ by which it is distinguished from the corresponding molybdenum(VI) complex. Several factors are examined for the extractability of the complex in the first extraction and the absorbance of the polycomplex formed by the second shaking. In the analytical condition, the sensitivity increases about four times as much as that of aqueous phase without lowering of the selectivity. Molybdenum(VI) and tungsten(VI) interfere seriously, but thorium(IV) and uranium(VI) only slightly. (auth)

9318 NEUTRON ACTIVATION ANALYSIS OF MICROGRAM AND SUBMICROGRAM QUANTITIES OF THORIUM IN ULTRAMAFIC ROCKS. Gangadharam, E. V. (Univ. of Saugar, Sagar, India); Parekh, P. P. Radiochim. Acta, 10: 65-8(1968).

A neutron activation method for determining thorium in the ppB level concentration in ultramafic rocks is described. The method is based on the assay of ^{233}Pa formed in the nuclear reaction: ^{232}Th (n,γ) ^{233}Th (β^-)/(22.1 min) ^{233}Pa ($t_{\frac{1}{2}}$ = 27.4 days). The 0.5 to 1 gram samples and 2.5 micrograms of thorium standards are irradiated at a thermal flux density of 5×10^{11}n · cm^{-2} · sec^{-1}, in the APSARA Reactor for a period of two weeks. After cooling for about two weeks, the irradiated sample is fused with potassium hydrogen fluoride and fumed with sulfuric acid. Hydroxides are precipitated, washed, and dissolved in nitric acid. Protactinium is coprecipitated on manganese dioxide. The precipitate is dissolved in 9M hydrochloric acid and loaded on to an ion-exchange column of IRA-400. Protactinium is eluted with 9M HCl + 1M HF. The eluate is collected and dried; the residue is taken up in nitric acid and the protactinium thus isolated from the irradiated sample is finally coprecipitated on manganese dioxide, filtered, and mounted for counting. A gamma spectrometer is used to count the 310-keV gamma rays from the standard and sample sources from which the amount of thorium is computed. The results of analysis of sixteen ultramafic rocks, three control samples of W-1, and five U.S.G.S. standards are presented. (auth)

9319 NEUTRON ACTIVATION DETERMINATION OF IRIDIUM IN METEORITES. Kimberlin, Jerome; Charoonratana, Chutatip; Wasson, John T. (Univ. of California, Los Angeles). Radiochim. Acta, 10: 69-76(1968).

An improved procedure for the neutron-activation determination of Ir in metallic and silicate meteorite samples was developed. Tests are reported, which indicate that complete exchange between Ir carrier and radioactivity can be obtained by prolonged heating of acidic dissolving mixtures used for metallic samples. Fusion of silicate samples in Na_2O_2 appears to give complete exchange. Iridium is separated from interfering radioactivities by use of cation- and anion-exchange steps, and by precipitation of hydrous IrO_2. Determinations are based on the counting of 74-day ^{192}Ir. The complex gamma peak at 0.31 MeV is measured in a large well-type scintillation detector. Recovery of Ir carrier is determined by reactivation. The precision of the procedure is about ±12% at the 96% confidence level. The detection limit for an integrated neutron flux of 4×10^{16} cm^{-2} is about 10^{-10} g. Results are reported for 11 chondritic- and 23 iron-meteorite samples. (auth)

9320 STREAM ANALYSIS VIA NEUTRON ACTIVATION. Can. Chem. Process, 52: 72-6(Dec. 1968).

A new analyzer is in the development process by Commercial Products, AECL. The analytic method is based on the fact that radioactive daughter elements are formed when atoms are activated by a beam of energetic neutrons. Each daughter radioisotope has a characteristic half-life and specific γ spectrum which allow precise determination of the type and quantity of elements present in the original stream. Good results can be obtained for 14 elements and somewhat less satisfactory results for a number of others. The construction and operation of the device are described. (F.S.A.)

9321 SIMULTANEOUS LIQUID SCINTILLATION DETERMINATION OF TRITIUM AND ^{35}S IN BIOLOGICAL LOW-LEVEL SAMPLES USING THE OXYGEN FLASK METHOD. Roncucci, R.; Lambelin, G.; Simon, M.-J.; Soudyn, W. (Continental Pharma, Brussels). Anal. Biochem., 26: 118-36(Oct. 10, 1968).

The combustion of biological samples for the simultaneous determination of ^{3}H and ^{35}S requires two trapping systems. Tritium is generally trapped as tritiated water by simple cooling while ^{35}S must be fixed by a chemical trapping agent (e.g., 2-phenylethylamine). When biological low-level samples must be assayed by the oxygen flask method, as occurs very often in human tracer studies, large amounts of material must be burned and consequently large amounts of the chemical trapping agent are used, which leads to an important increase of the quenching in the counting mixture. This increase can be avoided by adequate dilutions but, in the case of low activities, the counting rate must be easily distinguished from the background rate. In this last case a compromise between counting rate and quenching level (i.e., the dilution) must be found. A search was made for the most accurate and reliable experimental conditions that may be expected with the method described. Experiments were carried out on blood. Five radioactive levels (ranging from 9600 ^{3}H dpm/ml and 3200 ^{35}S dpm/ml to 600 ^{3}H dpm/ml and 200 ^{35}S dpm/ml) at four different quenchings (i.e., at different dilutions) for each level were assayed. The accuracy, the precision and the sensitivity of the method are discussed on a statistical basis and it appears to be essential that the best determinations for very low level samples are obtained at the lowest dilutions. (auth)

9322 DETERMINATION BY [NEUTRON] ACTIVATION OF IMPURITIES IN TUNGSTEN. APPLICATION TO THE ELECTRIC LAMP INDUSTRY. Eychenne, M.; Bayle, P.; Blanc, D.; Laverlochere, J.; Le Strat, J. (Centre de Physique Atomique et Nucleaire, Toulouse). Chim. Anal. (Paris), 49: 355-60(1967). (In French).

The sample (0.1 g) and a standard (10 to 250 μg of W solution) are irradiated in a neutron flux of ≃ 3×10^{13} neutrons per cm^2 per sec for periods from 10 sec (for Al) to 1 week (for Ag, Ca, P, and S). When O and Si are being determined the irradiation must be effected with 14-MeV neutrons. After dissolution of the metal and adjustment of the final solution to be 2M in HF, the radioisotopes (except those of Al, Mn, Ti, and V, which are short-lived and are therefore determined non-destructively) are separated by the ion-exchange scheme described. In this, seven short columns are used, each packed with either Dowex 1 or Dowex 50W resin; the elements in each eluate are identified and determined either by γ spectrometry or (for Ca, S, and P) by β counting. The scheme applies to >30 elements as well as the rare-earth metals; the lower limits of determination (μg) are—Al 0.1, Cu 0.3×10^{-4}, Zn 0.2, Rb 0.03, Ag 0.24, Ca 0.5, P 0.05, and S 5. The sensitivity for Si is 500 μg, which is insufficient. The method has been applied to new and used tungsten filaments of iodine-vapor lamps and to the black deposit on the quartz wall of used lamps. (Anal. Abstr.)

9323 USE OF ACETYLACETONE EXTRACTION FROM HALOGEN ACID MEDIUM IN DETERMINATION [BY RADIOACTIVATION] OF GALLIUM, INDIUM, AND COPPER IN LEAD AND IRON. Jaskolska, H.; Minczewski, J. (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw), 12: 697-700(1967).

The sample of lead (50 mg) and standard solution of Ga, In, and Cu were irradiated in a neutron flux of ≃ 10^{12} neutrons per sq cm per sec for 20 hr. The sample was dissolved in HNO_3 and carrier solution of Ga, In, and Cu (20 mg each) were added. The Pb was precipitated with HCl, the precipitate was filtered off, and the solution was evaporated to small volume and extracted with acetylacetone at pH 3. The organic phase (containing Ga, In, and Cu) was evaporated with a small volume of H_2O, concentrated HBr was added (to make the solution N in HBr) and the solution was extracted with acetylacetone. The organic phase (containing In) was washed with 1.2N-HBr and evaporated, the residual solution was diluted with H_2O, and In was precipitated as the 1:3 complex with 8-hydroxyquinoline. The aqueous phase, containing Ga and Cu, was evaporated with H_2O_2, then HCl was added (to make the solution 4N in HCl), and Ga was extracted with acetylacetone. Both phases were evaporated, the dry residues were dissolved in H_2O, and Ga was precipitated as the 1:3 complex with 8-hydroxyquinoline and Cu as CuSCN. The activities of the precipitate were measured with a Geiger–Mueller tube, and the contents of Ga, In, and Cu were calculated by reference to the activities of the precipitate separated from standards. To determine In in iron, the sample (50 mg) and an In standard were irradiated for 1 hr, then dissolved in HCl, the carrier (20 mg of In) was added, and the hydroxides of Fe and In were precipitated. The precipitate was centrifuged, then dissolved in HI (to make the solution 1.2N in HI), and the solution was extracted with acetylacetone. The organic phase was evaporated with H_2O, then with aqueous H_2O_2; In was precipitated as the 8-hydroxyquinoline complex, the precipitate was weighed and its activity was measured. The minimum determinable amount of Cu or Ga was 0.1 ng, and of In was 10 ng. (Anal. Abstr.)

9324 AUTOMATIC ANALYTICAL PROCEDURE FOR THE COLORIMETRIC DETERMINATION OF MOLYBDENUM IN STEEL. Braithwaite, K.; Hobson, J. D. (Dunford Hadfields Ltd., Sheffield, Eng.). Analyst, 93: 633-7(Oct. 1968).

A spectrophotometric method for the determination of molybdenum in steel, based on the color reaction with thiocyanate in the presence of tin(II) chloride and a titanium catalyst, was adapted for the Technicon AutoAnalyzer. The method is suitable for most steels, but small corrections may be needed in the presence of high concentrations of chromium, cobalt, and vanadium. Nickel, manganese, and silicon at the usual levels do not interfere. For low-alloy steels the initial solution is identical with that required

for Scholes' automatic method for manganese and phosphorus, but is modified when required to deal with high-speed steels containing alloying additions of tungsten. Results on standard steels are presented, and a statistical survey of long-term reproducibility is given. (auth) (UK)

9325 DIRECT SPECTROPHOTOMETRIC METHOD FOR DETERMINATION OF TRACES OF BORON IN IRON, STEELS, AND OTHER COMPOUNDS. Tolk, A.; Tap, W. A.; Lingerak, W. A. (Reactor Centrum Nederland, Petten). Talanta, 16: 111-15(Jan. 1969).

In the method described the absorbance of the boron-Curcumin complex formed in the sample solution is compared with the absorbance of another aliquot of sample solution wherein the boron is rendered inactive with fluoride before the Curcumin is added. (auth) (UK)

9326 ANALYSIS OF NATURAL RADIOACTIVE ELEMENTS IN GRANITIC ROCK SAMPLES BY GAMMA RAY SPECTROMETER. Nakai, Junji. Chishitsu Chosasho Geppo, 18: No. 9, 31-44(1967). (In Japanese).

A radiometric method of analysis was used on granitic rock samples in the boundary area between Tottori and Okayama Prefectures where sedimentary uraniferous ore deposits are distributed, and on samples from granitic bodies in Hiroshima Prefecture, Asahidake, and Ashio areas. Average content of uranium found in fresh granitic rock samples in mine areas of the Toge and Misasa districts are 4.1 ppM and 5.3 ppM, respectively; the latter may be higher than average for granitic rocks in Japan. Average Th : U ratios of these fresh samples were higher than those in the Ashio or Asahidake areas. Elastic wave velocity was measured by a supersonic method, showing that uranium content of samples from sedimentary uraniferous deposits decreases sharply with increasing grade of weathering. Uranium contents were extremely high in association with uraniferous deposits. (Geophys. Abstr.)

9327 STUDY OF THE INORGANIC COMPONENTS OF PLANTS BY RADIOACTIVATION ANALYSIS. APPLICATION TO THE PHYSIOLOGY OF TRACE ELEMENTS, TO TREATMENT CONTROL, TO POLLUTION, AND TO RADIO-ECOLOGY. Fourcy, A.; Neuburger, M. (CEN, Grenoble, France). Bull. Soc. Chim. Fr., No. 11, 4681-6(Nov. 1968). (In French).

The applications of activation analysis to botany and agriculture are discussed. The necessity of having precise agronomical experimental purposes for this analysis is pointed out. The following essential conditions are discussed: precision and sensitivity for standard compositions of vegetal materials; rapidity and advantages of the method considering the percentage ranges; and application to natural samples. Two modes of radioactivation were used: thermal neutrons from atomic reactors and rapid 14-MeV neutrons. The titration of about 25 elements was carried out. This type of analysis can be applied to the physiological study of inorganic elements, to ecology, biochemistry, foliage diagnosis, deficiency in oligo-compounds, comparison of genotypes, trace analysis, pesticides, livestock food, toxic residues, pollution, radio-ecology, identification by non-radioactive marking, as well as to the analysis of flours, papers, wood, coffee, and tobacco. (auth)

9328 RADIOCHEMICAL SEPARATION OF ^{18}F FROM IRRADIATED SEA WATER. Wilkniss, P. E.; Skinner, K. J.; Cheek, C. H. (Naval Research Lab., Washington, D. C.). Radiochim. Acta, 10: 76-8(1968).

Radiochemical procedures are described for the separation of ^{18}F from seawater irradiated with a linear accelerator or in a reactor. The fluorine is separated from the bulk of the sample by reaction with preformed $CaSO_4$. Final purification is achieved either by extraction of the fluorine with a solution of trimethylchlorosilane in benzene or by sublimation of NH_4F. The chemical yield of fluoride is determined by potentiometric titration utilizing a fluoride ion-specific electrode or by precipitation and measurement as PbClF. (auth)

9329 COMPLEXOMETRIC TITRATION OF RARE-EARTH METALS WITH N-METHYLANABASINEAZO-p-CRESOL ([3-(1-METHYL-2-PIPERIDYL)-2-PYRIDYLAZO]-p-CRESOL) AS INDICATOR. Talipov, Sh. T.; Krukovskaya, E. L. Nauch. Tr. Tashkent. Gos. Univ., No. 284, 29-35(1967). (In Russian).

This indicator (I) reacts with rare earth metals at pH 6.4 to 7.3 to form colored complexes that are decomposed by EDTA. Add 8 to 15 drops of 0.2 to 0.5% ethanolic I to the test solution, and titrate with 0.001 M to 0.01 M-EDTA; at the end of the titration add 10 to 20 ml of M-hexamine or M-Na acetate to maintain the pH at 6.4 to 7.3, and continue the titration to a color change from pink-violet to yellow. The results agree with those obtained with xylenol orange as indicator. There is no interference from 1 to 6-fold amounts of Ca or 5 to 15-fold amounts of Mg. (Referativnyi Zh.)

9330 CONTRIBUTION TO CHEMICAL ANALYSIS BY ELASTIC SCATTERING OF CHARGED PARTICLES. Luthereau, Francois; Tousset, Jean (Univ., Lyon). Bull. Soc. Chim. Fr., No. 11, 4724-32(Nov. 1968). (In French).

An attempt was made to apply the principle of the elastic scattering of charged particles to the total analysis of a sample which can be dissolved. The homogeneous and very fine distribution of the constituents of the solution on a plastic support to produce very thin targets was realized by introducing a polymer in an aqueous phase by a previously described method. A thickness measurement of the supporting films based on the loss of energy of α particles during their crossing was established and its performance was controlled. This analytical scattering method exhibited a good selectivity for light elements and an excellent sensitivity for heavy elements. (auth)

9331 SEPARATION AND DETECTION OF ^{237}U FROM RADIOACTIVE FALLOUTS BY SOLVENT EXTRACTION METHODS. Suzuki, Toshio; Sotobayashi, Takeshi (Niigata Univ., Japan). Nippon Kagaku Zasshi, 89: 1084-6(Nov. 1968). (In Japanese).

A method for rapid separation of ^{237}U from radioactive fallout using high-molecular-weight amine and quaternary ammonium salt was studied. The sample was decomposed by fusion with Na_2CO_3, the melt was dissolved in HCl, and then evaporated. The residue was dissolved in 0.1 N HCl, ^{99}Mo-^{99m}Tc and the other anionic nuclides were extracted with tri-n-octylamine dissolved in xylene. The aqueous phase was adjusted to 3 N HCl and ^{237}U and ^{132}Te were quantitatively extracted with trioctylmethylammonium chloride dissolved in benzene. The U and Te in the organic phase were then stripped into 0.1 N HCl. The aqueous phase was adjusted to 0.5 N H_2SO_4, and U was extracted with tri-n-octylamine dissolved in xylene. The U was then stripped into 0.25 N HNO_3. The radioactivity of the evaporated sample was counted. The procedure was applied to highly radioactive fallout particles and rain water after the 5th and 7th Chinese nuclear tests. No detectable amount of radionuclides other than ^{237}U could be found in a γ-spectrum of the counting sample obtained through this procedure. (NSA of Japan)

9332 A METHOD OF ACTIVATION ANALYSIS FOR COMPETING REACTIONS BY USING REACTOR NEUTRON FLUX. Kato, Hidemasa (Hitachi Ltd., Tokyo). Hitachi Hyoron, 17: 292-8(July 1968).

A method of activation analyses for such competing reactions as (n,p) or (n,α) using a reactor neutron flux was studied. When the same radionuclide is produced from the matrix element and the objective element by different nuclear reactions, the weight ratio of the objective element to the matrix element W_2/W_1 is found by measuring the Cd ratio of the sample R_1 through the equation $W_2/W_1 = K\{(1/R_1 - 1) - (1/R_2 - 1)\}^{-1}$, where R_2 is the Cd ratio of the objective element, K is a constant, which depends on the neutron spectrum in the irradiation facilities, and both are measured in advance. This method was experimentally applied to determine Mn in Fe, Mg in Al, Na in Al, P in S, Si in S, Mn in Co, and Cu in Zn. The measurement of quantity of Mn in a high-purity Fe powder sample is shown in detail. Some advantages of the method are: (1) activation analysis accompanied by competing reactions is practicable; (2) the technique is very simple, because it is necessary only to measure the cadmium ratio; (3) since the competing products can be accurately measured by this method, high neutron density near the reactor core can positively be used for activation analysis; and (4) the measurement range can be changed by using different irradiation facilities in the reactor. (NSA of Japan)

9333 AN IMPROVED METHOD FOR COUNTING TRITIUM AND ^{14}C IN ACRYLAMIDE GELS. Basch, Ross S. (New York Univ., N. Y.). Anal. Biochem., 26: 184-8(Oct. 10, 1968).

A simple procedure, using N,N'-methylenebisacrylamide cross-linked gels, which requires a minimum of sample handling and yields efficiencies for tritium up to 40% is presented. The method is based on the observation that slices of acrylamide gel when placed in NCS reagent (a mixture of quaternary ammonium compounds soluble in toluene) swell rapidly and entrapped macromolecules diffuse out into the liquid phase in which they are readily counted. The efficiencies obtained with this method are sufficiently high that the analysis of doubly labeled experiments is greatly facilitated. (D.H.M.)

9334 SOLVENT EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF THORIUM(IV) WITH XYLENOL ORANGE. Otomo, Makoto; Wakamatsu, Yoshinobu (Hachinohe Technical Coll., Japan). Nippon Kagaku Zasshi, 89: 1087-9(Nov. 1968). (In Japanese).

A new method is described for the spectrophotometric determination of thorium(IV), which is based on the extraction of thorium-xylenol orange(XO) chelate into 1-butanol in the presence of 1,3-diphenylguanidine(DPG). The stable violet chelate

in the organic phase has an absorption maximum at about 578 mμ. The maximum and the constant absorbence is obtained when the pH of the aqueous phase is adjusted to 2.5 to 3.6. The effect of the concentrations of XO and DPG in the aqueous phase on the absorbence of the organic phase is examined, and the optimum conditions for the determination are deduced. A good linear relationship between the absorbence of the organic phase and the concentration of thorium is obtained in the concentration range from 2.8 to 16.6 μg per 20.0 ml. The molar extinction coefficient of the extracted chelate is about 93000 at 578 mμ, and the sensitivity of the reaction is 0.0020 $\mu g/cm^2$ for log I_0/I = 0.001. The composition of the extracted species is also discussed. (auth)

9335 AN IMPROVED PROCEDURE FOR ^{3}H AND ^{14}C COUNTING IN ACRYLAMIDE GELS WITH A NONAQUEOUS SCINTILLATION SYSTEM. Spear, Patricia G.; Roizman, Bernard (Univ. of Chicago). Anal. Biochem., 26: 197-200(Oct. 10, 1968).

A procedure for quantitation of radioactive proteins in acrylamide gel segments with improved efficiency in a nonaqueous liquid scintillation system is described. The gels were prepared with ethylene diacrylate and the gel slices were hydrolyzed with concentrated NH_4OH in scintillation vials. Glass fiber paper was then inserted in the vial to absorb the sample. The paper was then dried and toluene base scintillation fluid added. Counting efficiencies of at least 15 to 20% for tritium and 65 to 70% for ^{14}C were obtained with this nonaqueous scintillation system. (D.H.M.)

9336 DITHIZONE AS AN INDICATOR IN THE COMPLEXOMETRIC TITRATION OF ZIRCONIUM. Goldstein, M. (Ministere de la Defense, Tel-Aviv, Israel). Chim. Anal. (Paris), 50: 592-6 (Nov. 1968). (In French).

An accurate and rapid method for the determination of Zr by return titration of an excess of EDTA with zinc sulfate and which uses dithizone as an indicator was developed. Application of this method for the determination of Zr alone in zirconium powder and siccative zirconium and for the determination of Zr and Ni in zirconium–nickel alloys, using a double titration with the same titrating agent, in the same solution, without and with the addition of potassium fluoride is discussed. (auth)

9337 QUANTITATIVE METHODS OF ANALYSIS FOR LUTETIUM IN MINERALS. Boudin, A.; Dehon, M. (Univ. of Brussels). Geochim. Cosmochim. Acta, 33: 142-7(Jan. 1969). (In French).

In view of the potential geochronological value of the natural radioactivity of ^{176}Lu, three quantitative methods were developed for the measurement of lutetium in minerals: neutron activation based on radiochemical separation and beta-counting of ^{176m}Lu; nondestructive neutron activation analysis by gamma counting ^{177}Lu on a Ge–Li detector; stable isotope dilution and mass spectrometry. The three methods give concordant results for a gadolinite sample. (auth) (UK)

9338 ANALYSIS OF TRITIUM IN WATER: A COLLABORATIVE STUDY. Sodd, Vincent J.; Scholz, Kenneth L. (National Center for Radiological Health, Cincinnati). J. Ass. Offic. Anal. Chem., 52: 90-3(Jan. 1969).

A liquid scintillation procedure using 1,4-dioxane, naphthalene, PPO, and POPOP as the scintillator was evaluated in a collaborative study of the determination of tritium in water. The tritium counting efficiencies for seven collaborating laboratories using this technique and commercially available liquid scintillation spectrometers ranged from 8.3 to 26.5%. The minimum detectable activity by the method, based on 99% confidence limits, 100 min counting time, and backgrounds from 9 to 67 cpm, ranged from 0.2 to 0.5 pCi/ml. Statistical results showed no evidence for systematic error. The coefficient of variation varies from 3.4 to 7.3% over the concentration range 2.91 to 115.8 pCi/ml. (auth)

9339 DISPOSABLE RADIOIODINATION PIPET. Catt, K. J.; Culross, J. (Monash Univ., Melbourne). Anal. Biochem., 26: 207-9(Nov. 1968).

A disposable iodination pipet was constructed and tested. A glass capillary tube of 25-μl capacity was cemented into the bottom of a small polyethylene test tube of 400-μl capacity. The iodination pipet can be attached to a micropipet control unit that has been fitted with a Luer butt. Measurement, mixing, and transfer of iodination reagents can be rapidly performed within one pipet that may be discarded. (J.G.B.)

9340 STUDIES ON THE SULFUR-CONTAINING CHELATING AGENTS. 20. RADIOISOTOPE DILUTION METHOD FOR DETERMINATION OF MERCURY BY THIODIBENZOYLMETHANE. Tanaka, Hisashi; Nakanishi, Nobuko (Kyoto Univ.). Bunseki Kagaku, 17: 1428-32(Nov. 1968). (In Japanese).

Thiodibenzoylmethane was chosen among the various kinds of thio β-diketones for a chelating agent for mercury because of its ease of preparation and its high stability. Radioisotope dilution using thiodibenzoylmethane as the extractant was satisfactory for determination of amounts of mercury down to 10^{-7}g. A known amount of radioactive mercury (^{203}Hg) and a substoichiometric amount of thiodibenzoylmethane were added to the sample solution, and the chelate formed was extracted into chloroform at pH 4. The amount of Hg was calculated from the activity of the chloroform phase. Interferences from other metal ions were practically negligible. Thiodibenzoylmethane forms extractable chelates in chloroform with Co, Ni, Cu, Zn, Cd, and Pb, but it can not be considered as an excellent reagent for the spectrophotometric method because it has strong absorption in visible regions. Therefore, the radioisotopic tracer technique is considered to be particularly effective for the application of thiodibenzoylmethane as well as of the other thio-β-diketones. (NSA of Japan)

9341 RADIOCHEMICAL METHOD FOR THE QUANTITATIVE DETERMINATION OF ^{133}Xe AND ^{135}Xe. Lyle, S. J.; Sellars, J. (Univ. of Kent, Canterbury, Eng.). Radiochim. Acta, 10: 160-4(Dec. 1968).

A radiochemical method, convenient to carry out and relatively rapid, is described for the separation and determination of ^{133}Xe and ^{135}Xe in solid and liquid samples. The xenon activity is measured with high efficiency in a gas counter of the Geiger–Mueller type. A description of the calibration of the counter for absolute measurements is given. (auth)

9342 ^{148}Nd ANALYSIS FOR BURNUP DETERMINATION IN NUCLEAR FUELS. Koch, L.; Cottone, G.; Geerlings, M. W. (Europaeisches Institut fuer Transurane, Karlsruhe, Ger.). Radiochim. Acta, 10: 122-4(Dec. 1968). (In German).

To determine burnup in reactor fuels the ^{148}Nd is determined by isotope dilution analysis with ^{150}Nd. The neodymium is separated by a simplified method using α-hydroxyisobuyric acid. The neodymium fraction is identified by the ^{241}Am, which is eluted prior to neodymium. Evaluation of the analysis data takes into account the influences of natural neodymium, cerium, and samarium. A procedure is described. (auth)

9343 DETERMINATION OF ^{239}Pu AND ^{240}Pu IN IRRADIATED URANIUM FUELS BY ALPHA AND GAMMA SPECTROMETRY. Mannone, F.; Bresesti, M.; Caporali, G. (CCR EURATOM, Ispra, Italy). Radiochim. Acta, 10: 124-8(Dec. 1968).

A method was developed for radiometric determination of the ^{239}Pu and ^{240}Pu contents in irradiated uranium fuels. The sum of the $^{239}Pu + ^{240}Pu$ activities is determined by isotopic dilution with ^{236}Pu and alpha spectrometry and by $4\pi\alpha$ counting. The ^{239}Pu activity is determined by gamma spectrometry with Ge(Li) and/or NaI(Tl) detectors. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 9299, 9300, 9422, 9444, 9506, 9511, 9525, 10996, 11017, and 11190.

9344 (BNL–11611) THERMODYNAMICS OF FISSION PRODUCT–SODIUM SOLUTIONS. Castleman, A. W. Jr.; Tang, I. N. (Brookhaven National Lab., Upton, N. Y.). [1966]. 5p. Dep. CFSTI.

Investigations were made of the thermodynamic properties of sodium–fission product solutions. Fission product partial pressure and the extent of their vaporization were calculated. (M.C.G.)

9345 (BNL–13114) STUDY OF REACTIONS BETWEEN OXYGEN AND IMPURITIES IN SODIUM. Isaacs, H. S.; Minushkin, B.; Salzano, F. J. (Brookhaven National Lab., Upton, N. Y.). Nov. 27, 1968. 17p. (CONF-681106-7). Dep. CFSTI.

From Conference on Sodium Technology and Large Fast Reactor Design, Argonne, Ill.

Reactions were found to occur between the components of stainless steel and oxygen in sodium. These reactions can act to buffer the oxygen activity in the system. At 500°C it is probable that chromium is one of the metals that react with oxygen. The buffering action suggests that the reaction involves an equilibrium between a reduced and oxidized chromium-oxygen compound and that two solid phases are present in the system. The equilibrium oxygen concentration for this reaction at 500°C is tentatively set at 17 ppM. Above this concentration chromium can getter oxygen from sodium, and below this concentration the oxidized specie can supply oxygen to the system. (auth)

9346 (COO–1140–174) PROGRESS REPORT, NOVEMBER 1, 1967–OCTOBER 31, 1968. [Gilles, Paul W.] (Kansas Univ.,

Lawrence. Dept. of Chemistry). Contract AT(11-1)-1140. 26p. Dep. CFSTI.

Research is being carried out on the chemistry of the titanium–oxygen system, the properties of borides, the chemistry of high-molecular-weight boron sulfides, and chemical transport reactions. (M.C.G.)

9347 (COO-1149-136) LOW-TEMPERATURE CHEMICAL THERMODYNAMICS PROJECT. Technical Progress Report No. 16, November 1967–November 1968. Westrum, Edgar F. Jr. (Michigan Univ., Ann Arbor. Dept. of Chemistry). Nov. 1, 1968. Contract AT(11-1)-1149. 69p. Dep. CFSTI.

Research progress is reported on: actinide compounds and materials of nuclear energy relevance, lanthanide compounds, heat capacities of miscellaneous compounds, and various experimental procedures. (M.C.G.)

9348 (COO-1780-3) STABLE ISOTOPE TRACER STUDIES. Progress Report, March 1, 1968–February 28, 1969. Gordon, Gilbert (Iowa Univ., Iowa City. Dept. of Chemistry). Nov. 20, 1968. Contract AT(11-1)-1780. 11p. Dep. CFSTI.

The rapid mixing and mass spectrophotometric equipment were improved and calibrated. The reactions between U^{4+} or Fe(phenanthroline)$^{2+}$ and sodium chlorite are being studied. The reactions of chlorate and chlorite ions and chlorine dioxide with Fe(phenanthroline)$^{2+}$ were studied. Several oxidants were also reacted with Fe(phenanthroline)$^{2+}$ and the products studied. The effects of a variety of catalysts on oxygen transfer reactions and isotopic exchange reactions are being studied. (M.C.G.)

9349 (CEA-Bib-124) MOLYBDENUM HEXAFLUORIDE (MoF_6). Carles, Maurice (Commissariat a l'Energie Atomique, Pierrelatte (France)). Sept. 1968. 27p. (In French). Dep.

MoF_6 is generally prepared by direct synthesis of its components. The molecule is entirely symmetrical in structure; the metal atom is located in the center of an octahedron the apexes of which are occupied by fluorine atoms. When cold, this compound appears as a crystallized white solid body. It melts around 17.5°C and boils around 35°C under air pressure. Very sensitive to hydrolysis and reduction, molybdenum hexafluoride forms addition compounds with sodium, potassium, rubidium, and cesium fluorides. It also forms complex compounds with nitrile and nitrosyl fluorides and nitrogen oxides. The reactivity of this symmetrical molecule shows the nonsaturation properties of molybdenum regarding coordination. Inversely, the high inertia of sulfur and selenium hexafluoride molecules, which are similar, is to be noted. (115 references). (auth)

9350 (CEA-Bib-125) TUNGSTEN HEXAFLUORIDE (WF_6). Carles, Maurice (Commissariat a l'Energie Atomique, Pierrelatte (France)). Sept. 1968. 30p. (In French). Dep.

WF_6 is generally prepared either from tungsten hexachloride and hydrofluoric acid used as a reactant or by direct synthesis of its components. It appears as a colorless gas ten times denser than the air. Solid tungsten hexafluoride is a white body which melts around −0.4°C and boils around 17°C under air pressure. Symmetrical in structure, the molecule consists of one metal atom in the center of an octahedron the apexes of which are occupied by fluorine atoms. Highly reacting, tungsten hexafluoride fumes in the air and corrodes practically all metals except gold and platinum. It forms addition compounds with sodium, potassium, rubidium, cesium, manganese, and ammonium fluorides and also with some nitrogen compounds like nitrile and nitrosyl fluorides and N_2O_4 oxide. It can be reduced by many compounds such as HCl, HBr, HI, and CO to give subfluorides. Metal tungsten hexafluoride is obtained with high temperature hydrogen. This reaction is often used to obtain deposit films or to make tungsten objects. (124 references). (auth)

9351 (CEA-R-3496) OXIDATION OF URANIUM MONOCARBIDE IN DRY OR MOIST OXYGEN. Herrmann, Brigitte; Herrmann, Franz-Josef (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). June 1968. 19p. (In French). Dep.

The kinetics of oxidation of uranium monocarbide either in dry or moist air or in oxygen–argon mixtures, was studied thermogravimetrically, between 500 and 800°C in a circulating atmosphere. In all cases the oxidation led to the formation of U_3O_8. Between 500 and 700°C, the activation energy was about 21 ± 3 kcal/mole. It seems to decrease between 700 and 800°C, but the reaction follows always a linear rate law. In moist air, the oxidation proceeds more swiftly, due to an increase in the reactional interface. An evaluation of the overtemperature was made at 800°C. (auth)

9352 (EUR-4059) RELEASE OF FISSIONABLE MATERIAL AND FISSION PRODUCTS FROM NUCLEAR FUELS AND SINTERED MICROSPHERES AT HIGH TEMPERATURE. Merz, E.; Laser, M. (Kernforschungsanlage, Juelich (West Germany)). May 21, 1968. 21p. (In German). Dep.

Uranium, thorium, and their compounds, as well as sintered microspheres of fissile and fertile materials were irradiated and heated up to temperatures from 1800 to 2000°C in vacuo. The vaporized components were condensed on a water-cooled aluminum condenser foil and analyzed by α, β, and γ spectrometry. As indicated by the results, the rate of vaporization of uranium and thorium on the one side, and of fission products on the other side are not connected by a simple relation. However, some transport and vaporization mechanisms are discussed. (auth)

9353 (NYO-3663-3) ISOTOPE EFFECTS ON RATE AND EQUILIBRIUM PROCESSES. Annual Progress Report, December 1, 1967–November 30, 1968. Stern, Marvin J. (Yeshiva Univ., New York. Belfer Graduate School of Science). Nov. 30, 1968. Contract AT(30-1)-3663. 78p. Dep. CFSTI.

The theoretical merits of computing isotope effects using isotopic frequencies calculated from a best-fit force field, rather than directly from observed frequencies, are discussed. It is shown that good agreement is obtained, between the experimental and theoretical separation factors for the "$NO_3^- - NO_3^-$" and "$NO - NO_2^-$" isotope exchange systems, when the partition-function ratios are properly calculated and the actual chemical compositions of the systems are taken into account. The prediction that small changes in force fields might alter the characteristics of the temperature dependence exhibited by an isotope-exchange equilibrium constant, but should not affect significantly the overall prevalence of temperature-dependence "anomalies", is supported by new calculations. Studies of the temperature dependences of equilibrium isotope effects are being extended to ^{13}C and D effects. Some general problems involved in carrying out a theoretical study of the temperature dependences of kinetic isotope effects are discussed. Large bodies of kinetic isotope-effect data, corresponding to model reactions, are being collected for theoretical studies of kinetic isotope effect temperature dependences and of relative T-D and $^{14}C - ^{12}C$ isotope effects. Some preliminary conclusions from these studies are presented. Tests of a statistical method of extracting the classical contribution to a kinetic isotope effect from experimental data indicate that the results obtained with the method may be fairly dependent on the temperature range of the data considered. (auth)

9354 (ORNL-4333) X-RAY DIFFRACTION DATA ON THE SYSTEM TETRA-n-BUTYLAMMONIUM FLUORIDE–WATER AT 25°C. Narten, A. H. (Oak Ridge National Lab., Tenn.). Dec. 1968. Contract W-7405-eng-26. 47p. Dep. CFSTI.

The scattering of x rays from a saturated solution of tetra-n-butylammonium fluoride in water was measured and analyzed at 25°C. The radial distribution function for the solution is surprisingly similar to that of pure water at the same temperature. Each water molecule has ~3.8 neighbors at an average distance of 2.80 Å, compared to ~4.4 neighbors at 2.85 Å in pure water. Intensity and radial distribution functions, calculated for two different models, are compared to those derived from the diffraction data. The respective models assume modified ice-I and gas hydrate structures, surrounded by a random distance distribution, as an adequate description for the average short-range order in the solution. In both models the F^- and N^+ atoms of the cations are part of a hydrogen-bonded network, while the butyl chains of the cations are located inside the cavities which, although of different size and shape, are typical for both structures. The ice-I model explains the x-ray data of the solution and of pure water, while the gas hydrate model is shown to be incompatible with the experimental radial distribution function of liquid water. The raw data, the reduced intensity and radial distribution functions derived from them, and the least-squares refined parameters of the two models for the liquid solution are presented in tabulated form. (auth)

9355 (ORNL-4343, pp 59-61) OPTICAL AND ELECTRON MICROSCOPY. (Oak Ridge National Lab., Tenn.).

Optical and electron microscopy and electron diffraction as applied to studies on lanthanide hydroxide sols and absolute filters at elevated temperatures and the characterization of good and bad Varcum, which is a furfuryl alcohol derivative, is reported. Observations of radioactive materials have continued in connection with a NASA project and with the MSRE. An electron-beam vaporizer is being used to produce ultrapure thin films. (P.C.H.)

9356 (ORNL-4343, pp 84) INORGANIC PREPARATIONS. (Oak Ridge National Lab., Tenn.).

Developments in the preparation of inorganic compounds are reported. Some of the compounds mentioned include anhydrous

materials, ferrites, halides, gold alloys, intermetallic compounds, isotopic compounds, and compounds of nickel in various valence states. (P.C.H.)

9357 (ORNL-4343, pp 91-3) SPECTROMETRY. (Oak Ridge National Lab., Tenn.).

The half-lives of ^{242}Pu and ^{244}Pu were measured and the new values are given. Work was also done to measure the half-lives of some other transuranium elements. Various samples of organic, organometallic, and inorganic nature were examined by ir spectrometry. Most studies involved the detection or identification, or both, of impurities in commercial products and in compounds synthesized at ORNL; identification of commercial products; characterization of organic compounds; determination of impurities; or identification of structural changes in both organic and inorganic materials caused by irradiation, chemical reaction, or thermal effects. NMR spectra, along with the mass (MA) and infrared (ir) spectra, were used to determine the structure of various organic compounds. Various polymers such as polymethylenepolyphenylisocyanate (PAPI), Varcums (polymers of furfuryl alcohol), organophosphorus polymers, and polymers of furan aldehyde were also examined. Their NMR spectra indicate that most of them are mixtures. (P.C.H.)

9358 (ORNL-TM-2335) SOLUBILITY OF CESIUM TRIFLUORIDE IN MOLTEN MIXTURES OF LiF, BeF_2, AND ThF_4. Fredricksen, Judy A.; Gilpatrick, L. O.; Barton, C. J. (Oak Ridge National Lab., Tenn.). Jan. 1969. Contract W-7405-eng-26. 25p. Dep. CFSTI.

The solubility of CeF_3 was determined at various temperatures in six mixtures of LiF, BeF_2, and ThF_4 of the type that may be used to fuel a molten salt breeder reactor. Comparison of earlier data on the solubility of PuF_3 and CeF_3 in fluoride solvents makes it possible to predict that the solubility of PuF_3 in single-region fuel compositions at reactor operating temperatures will be more than adequate. The solubility data as a function of solvent composition were best correlated by a model that assumes BeF_2 to be complexed as the BeF_4^{2-} ion and ThF_4 as the ThF_5^{1-} ion. (auth)

9359 (TID-4051(1st Ed.)) SUMMARIES OF THE USAEC BASIC RESEARCH PROGRAM IN CHEMISTRY (OFF SITE). (Division of Research (AEC), Washington, D. C. Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Jan. 1969. 122p. Dep. CFSTI.

Summaries of current projects being supported by the Office of Chemistry Programs of the Division of Research under its off-site program are reported. This includes the objectives and current status of the individual research efforts in effect on June 30, 1968. The contract summaries are arranged with cross-referencing in the following chemistry subdiscipline categories: heavy element; nuclear; hot atom; radiation; structural and theoretical; isotope effects; high-temperature; inorganic; physical; analytical; geochemistry; and nuclear engineering and separations chemistry. Each summary includes the name and address of the principal investigator, the date on which the summary was received, the AEC contract number, and usually a list of publications in the open literature resulting from the research within the past year. Principal investigator, corporate author, and subject indexes are included. (P.C.H.)

9360 (UCRL-18216) CHEMICAL BIODYNAMICS. Annual Report, 1967. (California Univ., Berkeley. Lawrence Radiation Lab.). June 1, 1968. Contract W-7405-eng-48. 130p. Dep. CFSTI.

Four sections are included; separate abstracts were prepared for three. The remaining section contains information on organic chemistry and geochemistry. (P.C.H.)

For abstracts of individual sections see: 9361, 9426, and 9845.

9361 (UCRL-18216, pp 45-80) BIOPHYSICAL CHEMISTRY AND BIOPHYSICS. (California Univ., Berkeley. Lawrence Radiation Lab.).

CHLOROPHYLL — reactions with chloroplast lipids, in vitro — excitation transfer by, in monolayers in relation to interactions with chloroplast glycolipids
CHLOROPLASTS — reactions of spinach, with light, functional photosynthetic unit sizes for
NUCLEIC ACID, DEOXYRIBO — stability of T7 bacteriophage, in potassium trifluoroacetate, equation for measuring
NUCLEIC ACID, RIBO — structure of, linear sequence of bases and three-dimensional arrangement of molecules in relation to
SCHIZOMYCOTA — Rhodospirillum rubrum, photosynthetic components of, effects of light and temperature on EPR signals for
TRITIUM — determination on thin-layer chromatograms, use of scintillators and polyethylene adsorbants for (E.R.B.)

9362 (UCRL-18476) AN ABSOLUTE TEMPERATURE SCALE FOR CERIUM MAGNESIUM NITRATE BELOW 0.002°K. Huntzicker, James John (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1968. Contract W-7405-eng-48. 170p. Dep. CFSTI.
Thesis.

The absolute temperature scale for single-crystal cerium magnesium nitrate (CMN) was extended to S/R = 0.002 by adiabatic demagnetization from values of H/T up to 68 kOe/°K. The temperature dependence of the highly anisotropic angular distribution of the 255-keV γ ray from oriented ^{137m}Ce in the CMN provided the thermometric parameter. The nuclear orientation results were interpreted with the spin Hamiltonian $H = g_J\beta H_x S_x + B(S_x I_x + S_y I_y)$ where H_x (a calculated dipolar field) = 60.67 Oe and B/k = 0.00820 ± 0.00042°K. The hyperfine structure constant B was determined by normalizing the nuclear orientation results to the calorimetric results of Hudson and Kaeser in the entropy range $0.063 \leq (\ln 2 - S/R) \leq 0.164$. Analytic relations between temperature and entropy are presented for the entropy range $0.002 \leq S/R \leq 0.640$. The lowest temperature measured was 0.00135 ± 0.00008°K. The present results are in reasonable agreement with both the earlier nuclear orientation results of Frankel, Shirley, and Stone and with the calorimetric results of Hudson and Kaeser. These results and the results of Hudson and Kaeser are compared in detail. The effect of recent high-field magnetization measurements on the CMN temperature scale are discussed. The ^{137m}Ce γ thermometer was also used to investigate the thermal behavior of cerium zinc nitrate (CZN). The preliminary nuclear orientation results indicate a high degree of similarity between CZN and CMN. (auth)

9363 THE RED AND WHITE FORMS OF THORIUM OXYDIIODIDE AND THEIR TRANSPORT REACTIONS. Corbett, John D.; Guidotti, Ronald A.; Adolphson, Douglas G. (Ames Lab., Iowa). Inorg. Chem., 8: 163-5(Jan. 1969).

Synthesis and interconversion reactions of the red and white forms of thorium oxydiiodide are reported. The results of ESR measurements and x-ray diffraction studies are given. It was concluded that sublimation of $ThOI_2$ to the cooler end of the container during synthesis involves a chemical-transport reaction, the kinetics of which are discussed. (J.G.B.)

9364 DEUTERIUM SOLVENT ISOTOPE EFFECT ON A PHOTOCHEMICAL REACTION. Jorgenson, Margaret J. (Univ. of California, Berkeley). J. Amer. Chem. Soc., 91: 198-200 (Jan. 1, 1969).

Photochemically induced double-bond migration in α,β-unsaturated esters was studied in methanol and methanol-0-d. It was observed that irradiation in methanol-0-d has a decided effect on the reaction course. Variations in protonation behavior and isotope effects are discussed. (J.G.B.)

9365 EQUILIBRIUM MEASUREMENTS IN THE MOLYBDENUM-CARBON-HYDROGEN SYSTEM. Solbakken, A.; Emmett, P. H. (Johns Hopkins Univ., Baltimore). J. Amer. Chem. Soc., 91: 31-4(Jan. 1, 1969).

Equilibrium values for the reaction of molybdenum with methane to form Mo_2C and hydrogen were determined over the temperature range 450 to 650°. The results yield values for the free energy of formation of Mo_2C in good agreement with those reported by Gleiser and Chipman [M. Gleiser and J. Chipman, J. Phys. Chem., 66: 1539(1962)]. The data previously reported by Browning and Emmett [L. C. Browning and P. H. Emmett, J. Amer. Chem. Soc., 74: 4773(1952)] are in error, apparently because of contamination of the equilibrating system with a small amount of molybdenum oxide. (auth)

9366 SUBLIMATION OF STRONTIUM SULFIDE AND THE DISSOCIATION ENERGY OF SrS. Cater, E. David (Univ. of Iowa, Iowa City); Johnson, Ernest W. Contract AT(11-1)-1182. J. Chem. Phys., 7: 5353-7(Dec. 15, 1967). (COO-1182-17).

The sublimation of strontium sulfide in the temperature range 1543 to 2122°K was studied by mass spectrometric and vacuum balance effusion techniques. Partial pressures of the vapor species Sr, S, S_2, and SrS were derived. Results were compared with those of Marquart and Berkowitz and of Colin, Goldfinger, and Jeunehomme. Best values obtained from second- and third-law calculations based on the dissociation energy of sulfur $D_0(S_2) = 101$ kcal/mole gave the following heats of reaction: SrS(s) = Sr(g) + S(g), $\Delta H_0^\circ = 132 \pm 4$ kcal/mole; SrS(s) = Sr(g) + S(g), $\Delta H_0^\circ = 212 \pm 5$ kcal/mole; SrS(g) = Sr(g) + S(g), $\Delta H_0^\circ = 80 \pm 4$ kcal/mole = 3.5 ± 0.2 eV; and S(s) + Sr(s) = SrS(s), $\Delta H_{f,298}^\circ = -108 \pm 4$ kcal/mole. (auth)

9367 INVESTIGATIONS ON THE SORPTION OF GASEOUS URANIUM HEXAFLUORIDE ON SOLID BARIUM FLUORIDE. Korinek, K.; Peka, I. (Inst. for Nuclear Research, Rez, Czech.). Collect. Czech. Chem. Commun., 33: 3113-21(Oct. 1968). (In German).

By means of a statistical method, the effects of temperature,

UF_6 vapor pressure, reaction time, and specific surface area of the sorbent on the course of the sorption of gaseous UF_6 on solid BaF_2 were determined. The reaction mechanism is postulated. (tr-auth)

9368 PRELIMINARY EVIDENCE FOR COMPLEX FORMATION OF TRIVALENT URANIUM IN MOLTEN ALUMINIUM CHLORIDE. Poturaj-Gutniak, Stefan (Inst. of Nuclear Research, Warsaw). Nukleonika, 13: 1157-60(1968).

The fused salt $AlCl_3$–UCl_3 system was investigated. The vapor pressure of aluminum chloride over the solution of 14.0 mole % UCl_3 and 86.0 mole % $AlCl_3$ was determined. Changes in the activity and excess chemical potential of aluminum chloride suggest the existence of the $U(Al_2Cl_7)_3$ complex. (auth)

9369 AROMATIC SULPHONATION. PART XXII. KINETIC ISOTOPE EFFECTS IN THE REACTION OF [1,3,5-$^2H_3$] BENZENE WITH SULPHUR TRIOXIDE: COMPETITIVE SULPHONATION OF BENZENE AND TOLUENE. Bosscher, J. K.; Cerfontain, H. (Univ. of Amsterdam). J. Chem. Soc., B, No. 12, 1524-6(1968).

The kinetic isotope effects of hydrogen in the sulfonation of [1,3,5-$^2H_3$]benzene in trichlorofluoromethane were determined as $k_H/k_D = 1.23 \pm 0.08$ at −35°; with nitromethane as solvent $k_H/k_D = 1.34 \pm 0.08$ at 20°. The kinetic isotope effect for the accompanying sulfonylation in trichlorofluoromethane was found to be $k_H/k_D = 1.1 \pm 0.1$ at −35°. These results are discussed in terms of the recently established mechanism for aromatic sulfonation with sulfur trioxide in aprotic solvents. It was determined, by competitive experiments, that the sulfonation rate ratio of toluene to benzene and the degree of para-substitution in toluene were greater with nitromethane than with trichlorofluoromethane as solvent. The apparent greater selectivity in the case of the former solvent is explained in terms of complex formation between sulfur trioxide and nitromethane. (auth) (UK)

9370 CRYSTAL CHEMISTRY OF RADIUM. III. PREPARATION, CRYSTAL STRUCTURE, AND ATOMIC RADIUS OF METALLIC RADIUM. Weigel, F.; Trinkl, A. (Univ., Munich. Technische Hochschule, Munich). Radiochim. Acta, 10: 78-82(1968). (In German).

Metallic radium was prepared on the microgram scale by reduction of radium oxide with aluminum in a high vacuum. The metal was sublimed directly into an x-ray capillary. From x-ray studies on radium metal mirrors obtained by this method, it was found that radium has a bcc structure with $a_0 = 5.148 \pm 0.015$ Å, space group O_h^9 – Im3m, and that t is isomorphous with barium metal. The x-ray density for N = 2 atoms in the unit cell is calculated to be 5.50 gcm^{-3}. From this value, an atomic volume of 40.92 cm^3 is derived. For coordination number 8, the atomic radius is found to be 2.23 ± 0.01 Å, standardization for coordination number 12 yields a value of 2.32 ± 0.02 Å for the corrected radius. The system of actinide metal radii derived by Zachariasen, Cunningham, and Wallmann is revised using radium as the reference standard. (auth)

9371 KINETICS AND MECHANISM FOR THE HYDROLYSIS OF PHENYL ORTHOFORMATE. Price, M.; Adams, J.; Lagenaur, C.; Cordes, E. H. (Indiana Univ., Bloomington). J. Org. Chem., 34: 22-5(Jan. 1969).

The kinetics of hydrolysis of phenyl orthoformate in moderately concentrated solutions of mineral acids were investigated in both 40% aqueous dioxane and in water containing approximately 0.01 M tetradecyltrimethylammonium chloride as solubilizing agent. The observed rate constants for this reaction in both solvents increase with increasing acid concentration but do so less rapidly than the increase in h_0 values. The entropy of activation for this reaction in the presence of 1 M hydrochloric acid is near −6.6 eu in water containing surfactant and −11.5 eu in 40% aqueous dioxane. The kinetic solvent deuterium isotope effect for phenyl orthoformate hydrolysis, k_{D_2O}/k_{H_2O}, is near 2 in 0.01 M surfactant solution and unity in 40% aqueous dioxane. These findings are consistent with and provide modest support for the involvement of proton transfer in the rate-determining step for this reaction. (auth)

9372 ACIDITY OF HYDROCARBONS. XXX. KINETIC ISOTOPE EFFECTS OF THE CESIUM CYCLOHEXYLAMIDE CATALYZED PROTON EXCHANGE OF CYCLOHEXANE WITH CYCLOHEXYLAMINE. Streitwieser, A. Jr.; Young, W. R.; Caldwell, R. A. (Univ. of California, Berkeley). J. Amer. Chem. Soc., 91: 527-8(Jan. 15, 1969).

A primary isotope effect that supports a normal carbanion mechanism for the cesium cyclohexylamide-catalyzed tritium exchange of cyclohexane with cyclohexylamine is reported. The primary isotope effect was determined by separately comparing cyclohexane and cyclohexane-d_{12} with cyclopentane and cycloheptane. The essentially normal magnitude of the primary isotope effect has two important implications: internal return is not important and the isotope effect for the reverse reaction of cyclohexylcesium with cyclohexylamine must have a comparable magnitude; that is, this reverse reaction is not of diffusion-controlled velocity, cyclohexylcesium must survive several collisions with solvent before reacting. (D.H.M.)

9373 ABSORPTION SPECTRA OF URANYL NITRATE CRYSTALS. Komyak, A. I.; Sevchenko, A. N.; Ditsh, E. V. Dokl. Akad. Nauk BSSR, 12: 769-72(Sept. 1968). (In Russian).

An analysis was made of the vibrational structure of uranyl nitrate crystals at room temperature. The presence of not less than four fields in the structure of the absorption spectrum, in which the frequency range remained almost constant, was established. From analysis of the relation of the absorption coefficient to the symmetry of the complex, it was concluded that these fields are related to the transition of uranyl ions between various excited states. (tr-auth)

9374 HYDROGEN–DEUTERIUM EXCHANGE IN LACTAMS. Chen, Catherine Y. S.; Swenson, Charles A. (Univ. of Iowa, Iowa City). J. Amer. Chem. Soc., 91: 234-7(Jan. 15, 1969).

The kinetics of hydrogen–deuterium exchange were measured for three cis lactams (butyrolactam, valerolactam, and caprolactam), the cis–trans lactam (caprylactam), and a trans amide (N-methylacetamide) in deuterium oxide solution. Exchange rates and activation energies (12 to 15 kcal/mole) are comparable for both the cis and trans configurations. Furthermore, activation energies are of a similar magnitude as those for other model peptides, polypeptides, and proteins. (auth)

9375 MELTING POINT OF Cm_2O_3. Smith, P. K. (E. I. du Pont de Nemours and Co., Aiken, S. C.). J. Inorg. Nucl. Chem., 21: 241-5(Jan. 1969).

Curium-244 oxide is being considered as a fuel material for thermionic isotopic power sources operating at temperature ~1750°C. The previously reported melting point of Cm_2O_3 (1950°C) appears low for several stated reasons, and a redetermination using oxide from several sources is reported in the communication. The value obtained is 2265 ± 20°C. Radiation damage was not thought to affect the melting temperature significantly. (UK)

9376 FLUORESCENCE CHARACTERISTICS OF INORGANIC COMPLEXES IN HYDROCHLORIC ACID MEDIUM AT LIQUID-NITROGEN TEMPERATURE. Kirkbright, G. F.; Saw, C. G.; West, T. S. (Imperial Coll. of Science and Tech., London). Talanta, 16: 65-73(Jan. 1969).

A study of the low-temperature fluorescence characteristics of the ions of 55 elements in concentrated hydrochloric acid is reported. The spectral characteristics, effects of hydrochloric acid concentration and time, calibration linearity and sensitivity for Sb(III), Bi, Ce(III), Pb, Te(IV), Tl(I), and Sn(IV) were investigated. Uranium(VI), copper(I), and antimony(V) also exhibited fluorescence under these conditions. The detection limits using a commercial spectrofluorimeter with modified sample cells were Sb(III), 10^{-6}M; Bi(III), 10^{-8}M; Ce(III), 10^{-7}M; Pb, 10^{-8}M; Te(IV), 10^{-7}M; Tl(I), 10^{-6}M; and Sn(IV), 10^{-4}M. The suitability of some inorganic acid solvents for clear glass formation at −196° was also investigated. (auth) (UK)

9377 SELF-DIFFUSION AND ISOTOPE EFFECT IN γ-IRON. Heumann, Th.; Imm, R. (Univ., Muenster, Ger.). J. Phys. Chem. Solids, 29: 1613-21(Sept. 1968).

The self-diffusion of the ^{59}Fe isotope in γ-iron was measured at 15 different temperatures between 1170 and 1361°C by the tracer-sectioning technique. The temperature dependence of the diffusion coefficient is given by $D = (0.49^{+0.10}_{-0.08}) \exp(-67860 \pm 1450/RT)$ cm^2/sec. The simultaneous diffusion of ^{55}Fe and ^{59}Fe in iron was also investigated at 6 temperatures in the above-mentioned interval. For the isotope effect E_B, which is defined by the equation: $E_B = 1 - (D_B/D_A)/1 - (m_A/m_B)^{\frac{1}{2}}$ where D_B/D_A and m_A/m_B are the ratios of the diffusion coefficients and masses of the two isotopes A and B, it was found that $E_{59} = 0.57 \pm 0.06$. According to Mullen (Phys. Rev., 121: 1649(1961)), who extended Schoen's theory, the isotope effect can be written as the product of the correlation factor f_2 and a factor ΔK. The determination of the latter from the measured E-value gives interesting indications of the possible course of the elementary jump process for diffusion in metals. (auth) (UK)

9378 DISSOLUTION OF HIGH-FIRED PLUTONIUM DIOXIDE. Chong, C. H. H.; Crockett, T. W.; Doty, J. W. Jr. (Monsanto Research Corp., Miamisburg, Ohio). J. Inorg. Nucl. Chem., 31: 81-3(Jan. 1969).

Plutonium-238 dioxide fired at temperatures above 1500°C can be readily dissolved in a mixture of 12 N HNO_3–0.1 N HF–0.1 N H_2SO_4. A 24-hr reflux period effectively converted 90 to 95% of the oxide to the nitrate form. (auth) (UK)

9379 SPECTROPHOTOMETRIC INVESTIGATION OF PLUTONIUM(VI) COMPLEX EQUILIBRIUM: PLUTONYL ACETATE.

Eberle, S. H.; Schaefer, J. B.; Brandau, E. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta, 10: 91-7(1968). (In German).

The absorption line at 8306 Å is well adapted for the quantitative determination of the plutonyl ions and for the investigation of complex reactions by means of spectrophotometry. The consumption of metal cations by the formation of complex compounds is indicated by a decrease of the extinction coefficient. At the same time new lines characteristic for the different complexes appear in the region of 8300 to 8500 Å. Using an electronic computer the stability constants of the Plutonium(VI)-acetato complexes were found to be: $\lg \beta_1 = 2.13 \pm 0.02$, $\lg \beta_2 = 3.49 \pm 0.07$, $\lg \beta_3 = 5.01 \pm 0.08$ for $\mu = 1.0$ and $\lg \beta_1 = 2.31 \pm 0.01$, $\lg \beta_2 = 3.80 \pm 0.03$ for $\mu = 0.1$ (25°C). The possibility of studying reaction equilibria by making use of such characteristic absorption lines is not only given for acetic acid but also for many other complexing agents. (auth)

9380 CURIUM–OXYGEN SYSTEM. Chikalla, T. D. (Battelle-Northwest, Richland, Wash.); Eyring, L. J. Inorg. Nucl. Chem., 31: 85-93(Jan. 1969).

Oxygen vapor pressures were measured over nonstoichiometric curium oxides in the temperature and pressure intervals of 300 to 900°C and 2 to 730 mm O_2. The resulting isobaric temperature-composition plots allowed deductions concerning the nature of the phase equilibria in the curium–oxygen system. The postulated phase diagram is characterized by two intermediate phases occurring at $CmO_{1.72}$ and $CmO_{1.82}$, while additional nonstoichiometric phases occur near the dioxide and sesquioxide compositions. All of the isobars showed pronounced hysteresis loops in the diphasic regions during heating and cooling cycles. (auth) (UK)

9381 PLUTONIUM TROPOLONATE COMPLEXES. Plymale, D. L.; Smith, W. H. (Monsanto Research Corp., Miamisburg, Ohio). J. Inorg. Nucl. Chem., 31: 233-5(Jan. 1969).

In an attempt to prepare stable compounds of plutonium-238 for possible use as primary standards, the plutonium-239 complexes of tropolone (2-hydroxy-2,4,6-cycloheptatrien-1-one) were investigated. The preparation and characterization of three new plutonium-239 compounds isolated from the reactions between plutonium(IV) and plutonium(VI) nitrate with tropolone are reported. Plutonium(VI) ion combines with tropolone in the ratios 1:2 and 1:3 to yield solid compounds which are analogous with the previously reported uranyl compounds. Plutonium(IV) ion reacts with tropolone to yield a 1:4 compound which appears analogous with the reported tropolone compounds of uranium and thorium(IV). Attempts to prepare a plutonium(III) tropolonate compound were not successful and only the plutonium(IV) compound was produced. (auth) (UK)

9382 DEPENDENCE OF URANIUM HEXAFLUORIDE SOLUBILITY IN PERFLUORODIMETHYLCYCLOHEXANE ON THE TEMPERATURE. Rak, V.; Petrzila (Inst. for Nuclear Research, Rez., Czech.). Collect. Czech. Chem. Commun., 33: 3374-7(Oct. 1968). (In German).

Measured solubility values are given in a table and graph. The solubility of UF_6 in perfluorodimethylcyclohexane decreased with decreasing temperature from 40 to −65°C. The dependence of the logarithm of the concentration of saturated solutions vs reciprocal value of the absolute temperature was linear. (M.C.G.)

9383 KINETICS, ISOTOPE RATE EFFECT, AND MECHANISM OF DEHYDROBROMINATION OF cis-1,2-DIBROMOETHYLENE WITH TRIETHYLAMINE IN DIMETHYLFORMAMIDE. Kwok, W. K.; Lee, W. G.; Miller, Sidney I. (Illinois Inst. of Tech., Chicago). J. Amer. Chem. Soc., 91: 468-76(Jan. 15, 1969).

The reaction between cis-dibromoethylene and triethylamine in dimethylformamide (DMF) is one of elimination rather than displacement. The probable first product is monobromoacetylene. The activation parameters for this second-order reaction are $\Delta H^{\ddagger} = 18.1$ kcal/mol and $\Delta S^{\ddagger} = -32$ eu. The isotope effect for elimination is $k_H/k_D = 1.00$, and there is neither rate retardation nor hydrogen exchange with cis-dibromoethylene, when triethylammonium or triethylammonium-d bromide is present during reaction. The reactivities of a few other compounds relative to cis-dibromoethylene with triethylamine in DMF were also estimated: $k(HCBr = CHN(CH_3)_3^+Br^-) \simeq 2500$ (40°); $k(trans\text{-}C_2H_2Br_2) \simeq 0.003$ (101.8°); $k(cis\text{-}C_2H_2Cl_2) \simeq 0.0064$ (101°); $k(HC \equiv CBr) \simeq 100$ (100°). To account for the observations on the cis-dibromoethylene, a novel $(E1cB)_{ip}$ or preequilibrium ion-pair mechanism is proposed, in which $(HCBr = CBr^-HN(C_2H_5)_3^+)$ is formed. Analogy for this elimination mechanism is found in the ion-pair processes of electrophilic substitution (S_E) reactions. The $(E1cB)_{ip}$ mechanism may provide a rationale for several "low" isotope effects, k_H/k_D. A reactivity scale, $sp^3 \sim sp > sp^2 > sp^{1.5}$, is also suggested for the SN reactions of triethylamine with various organic halides. (auth)

9384 URANYL THIOCYANATE COMPLEXES WITH SCN BRIDGE GROUPS. Vdovenko, V. M.; Skoblo, A. I.; Suglobov, D. N. Zh. Neorg. Khim., 13: 3059-62(Nov. 1968). (In Russian).

Coordinate uranyl complexes with a thiocyanate bridge group were identified by ir spectra which revealed that SCN^- bridge-type groups form in complexes with less than 5 ligands per uranyl ion. The observed complexes formed during saturation of ligand solutions in inert solution saturated with low-hydrate or anhydrous salts. Saturation of a 1 mole solution of tributyl phosphate in benzene with $UO_2(SCN)_2 \cdot H_2O$ formed a complex $UO_2(SCN)_2 \cdot (TBP)_2$ that, according to ir spectra, contained SCN^- bridge groups. Descriptions are given of the synthesis of uranyl thiocyanates of various hydrations, R_4 SCN and uranyl anion thiocyanate complexes. The composition of synthesized $UO_2(SCN)_2$ hydrates and $[UO_2(SCN)_2 \cdot (TBP)_2]$ complexes was determined by the analysis of the uranium and SCN^- content. The presence of water was determined by ν_{OH}. (R.V.J.)

9385 PRODUCTION OF URANIUM TETRAFLUORIDE. Rode, James A. (to United Nuclear Corp.). U. S. Patent 3,413,099. Nov. 26, 1968. Filed Nov. 14, 1966.

High-bulk-density UF_4 is produced by converting UF_6 in a fluidized bed reactor in which UF_4 particles are suspended by gaseous mixtures of UF_6, tetrachloroethylene, or an equivalent organic fluorine acceptor containing 1 to 3 C atoms, and a diluent, N_2. The temperature within the fluidized bed is in the range from 500 to 600°F, and the amount of tetrachloroethylene introduced into the fluidized bed is sufficient to provide a stoichiometric excess of about 9 to 12% for the conversion of UF_6 to UF_4. The excess UF_4 particles generated in the fluidized bed are removed from it. (Offic. Gaz.)

9386 CHROMOTROPE 2R AS AN INTERESTING CHROMOGENIC REAGENT. Shaha, V. L.; Sangal, S. P. (Univ. of Nagpur, India). Chim. Anal. (Paris), 50: 582-5(Nov. 1968). (In French).

Preliminary studies on the chromogenic reactions of chromotrope 2R (abbrv. CTR) were undertaken. The studies include the determination of the color reactions, wavelength of maximum absorbence, and the effect of pH and time on the stability of various chelates formed. (auth)

9387 PRODUCTION OF PLUTONIUM HEXAFLUORIDE BY FLUORINATION IN A FLUIDIZED BED. Levitz, N. M.; Vogel, G. J.; Carls, E. L.; Grosvenor, D.; Kullen, B.; Raue, D.; Murphy, W. (Argonne National Lab., Ill.). Nucl. Appl., 6: 147-55(Feb. 1969).

A total of 2.3 kg of PuF_4 was fluorinated to PuF_6 with elemental fluorine in a fluidized bed of alumina in three campaigns, each consisting of three separate fluorination runs followed by a fluorination-cleanup step in which any plutonium deposited in the lines and equipment was recovered. Each run involved 260 g of −325 mesh PuF_4 powder; a single ~6.5-kg bed of nominal 48-100 mesh alumina, was used in each campaign. A 93% F_2–7% N_2 gas mixture, which was recycled, served as the fluidizing gas and reactant. The temperature of the fluidized alumina bed was increased incrementally to 550°C, and the total fluorination time for each run was 3 to 5 hr. The PuF_6 was collected in traps at ~−65°C and subsequently sorbed on NaF. Plutonium material balances were 97, 101, and 99%. Average production rates of PuF_6 were 2.4 to 4.1 lb PuF_6/(hr ft²) but rates above 6 lb PuF_6/(hr ft²) were attained in initial 30-min fluorination periods. Fluorine utilization efficiency (the ratio of fluorine reacted to that which could theoretically react based on equilibrium considerations) averaged 22, 17, and 28% although efficiencies near 100% were calculated for the earlier portions of a run, when large quantities of plutonium were present. Over 96% of the plutonium charged was recovered as PuF_6 while ½% was discarded as waste in the alumina bed of the fluorinator. Less than 2% of the PuF_6 was decomposed to PuF_4 by radiation, and this was refluorinated and recovered without difficulty. (auth)

9388 THE OXIBASE SCALE AND DISPLACEMENT REACTIONS. XVIII. THE REACTION OF MERCAPTOETHYLAMINE WITH METHYL IODIDE AND WITH ETHYL TOSYLATE. Davis, R. E.; Molnar, S. P.; Nehring, R. (Purdue Univ., Lafayette, Ind.). J. Amer. Chem. Soc., 91: 97-103(Jan. 1, 1969).

The reaction of mercaptoethylamine (MEA) with methyl iodide to give the mono-S-methyl derivative was studied in aqueous solution as a function of pH and temperature. The rate expression is $-d[CH_3I]/dt = k_3[CH_3I][H_3N^+CH_2CH_2S^-] + k_4[CH_3I][H_2NCH_2CH_2S^-]$ with only the thiolate forms of MEA being kinetically important. The data were used to calculate the oxibase scale parameters of each thiolate anion. The factors influencing the reactivity of MEA as an antiradiation drug are discussed. The reaction of MEA with ethyl tosylate in aqueous buffer solutions was over the pH range of 5 to 12 from 25 to 53°. The product is S-ethyl MEA. The oxi-

base scale parameters of the various forms of MEA were obtained. The relationship of these data to the antiradiation drug is discussed. It is concluded that all of the existing theories would be correlated with the oxibase scale. A prediction is made concerning the design of better drugs. While some of the discussion is quite speculative, the theories do explain the experimental data. (auth)

9389 THERMAL BEHAVIOR OF COPRECIPITATED ZIRCONIUM HYDROXIDES AND SILICIC ACIDS. Polezhaev, Yu. M.; Ust'yantsev, V. M. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1544-9 (Sept. 1968). (In Russian).

Heating coprecipitated zirconium hydroxide and silicic acid to approximately 400°C caused dehydration with the formation of a vitreous substance. A further increase in temperature to 700 to 900°C caused the crystallization of low-temperature tetragonal ZrO_2 with subsequent regulation of the structure. At about 1200°C, the reaction for formation of zircon begins. The rate of this reaction increases with increasing temperature. At all the temperatures studied silica remained amorphous. It prevents the increase in ZrO_2 crystals and promotes their storage in tetragonal form. Alkali metal salt impurities cause the crystallization of silica and reduce the temperature for the beginning of the reaction for formation of zircon. (tr-auth)

9390 INTERNATIONAL SYMPOSIUM ON MACROMOLECULAR CHEMISTRY, PRAGUE, 1965. PART 7. Held Under the Auspices of the International Union of Pure and Applied Chemistry, Prague, August 30–September 4, 1965. Wichterle, O.; Sedlacek, B. J. Polym. Sci., Part C, No. 16, 3639-4258(1968). (In Several Languages). (CONF-650801–(Pt.7)).

The conference proceedings include 61 papers on various aspects of macromolecular chemistry. Separate abstracts were prepared for 6 papers. These papers deal with radiolysis of polymers in organic solutions, gaseous phase radioinduced polymerization, radiation degradation, and solid phase radioinduced polymerization. Some of the papers not abstracted deal with polymerization induced by methods other than radiation, structure of various polymers, properties of polymers in general and some in particular, and degradation of polymers by methods other than radiation. (B.L.M.)

For abstracts of individual papers see: 9453–9458.

9391 DIFFUSION OF CARBON IN MOLYBDENUM CARBIDE. Eremeev, V. S.; Panov, A. S. Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1507-12(Sept. 1968). (In Russian).

Reactions in the molybdenum–graphite system at 1270 to 2050°C were studied. The rate of increase of the carbide layer on molybdenum from its contact with graphite was limited by the diffusion mobility of carbon in MoC_2. The temperature relation of the coefficient of chemical diffusion was found by two different methods and the differences are discussed. (tr-auth)

9392 THE MOESSBAUER EFFECT. A Symposium, London, December 12–13, 1967. Symposia of the Faraday Society, No. 1, 1967. London, Faraday Society, 1967. 140p.

Eleven papers are included; separate abstracts were prepared for two. The remaining 9 papers contain information on: hyperfine interactions in Fe^{2+} salts; Moessbauer studies in spin $^3/_2$ Fe complexes; magnetic and electric hyperfine interactions of ^{57m}Fe nuclei in compounds $Y_{3-x}Ca_xFe_{5-x}Sn_xO_{12}$ ($0.0 \leq x \leq 2.0$); Moessbauer effect in the system $Sr_{1-x}La_xFeO_3$; calculation of chemical shifts in the Moessbauer spectra of some Sn(IV) compounds; isomeric chemical shifts of Moessbauer γ-lines in isoelectronic compounds of Sn, Sb, and Te; Moessbauer spectroscopy of stereochemically non-rigid and related organometallic molecules; migration of cations in two solid-state reactions; and application of the Moessbauer effect in ^{129}I as a spectroscopic tool for chemical structure and lattice dynamics investigation. (P.C.H.)

For abstracts of individual papers see: 9393 and 9394.

9393 ISOMER SHIFTS IN NEPTUNIUM COMPOUNDS. Stone, J. A.; Pillinger, W. L. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. pp 77-85 of The Moessbauer Effect. London, Faraday Society, 1967.

Characteristic isomer shift ranges were measured for several valence states of neptunium, using the Mössbauer resonance of the 59.54-keV gamma ray of ^{237}Np. Isomer shifts were observed for: various neptunium compounds as absorbers, with an ^{241}Am–Th alloy as a single-line source; and the charge states produced by alpha decay of various ^{241}Am compounds as sources, with a single-line NpO_2 absorber. Approximate shifts for the 0, +3, +4, +5, and +6 valences of neptunium are, respectively, 0.0, +4.1, +0.2, –1.5, and –3.5 cm/sec, with respect to NpO_2. These data show that the fractional change in nuclear deformation is negative and that the excited- and ground-state quadrupole moments are equal to within 1%. The unusually large isomer shifts observed, spanning more than 2000 natural line-widths, offer an extremely sensitive method for investigating chemical bonding in neptunium-containing systems. (auth) (UK)

9394 MOESSBAUER SPECTROSCOPY OF ^{61}Ni. Spijkerman, Jon J. (National Bureau of Standards, Washington, D. C.). pp 134-40 of The Moessbauer Effect. London, Faraday Society, 1967.

The Mössbauer effect of ^{61}Ni was observed using a single line source, prepared by 100 min LINAC irradiation. Of the many sources evaluated, a ^{62}NiCr (15%) gave the best results, with an f-factor of 0.1 and a linewidth of 0.097 cm/sec at 80°K. The source was activated by 100 MeV bremsstrahlung radiation using the ^{62}Ni(γ,p)^{61}Co reaction. The pulse height spectrum showed a single peak at 67.3 keV, with no interfering radiation. The 1.7 hr half-life of the source required repeated irradiations, but annealing was not required. Several alloys and compounds of nickel were examined, and showed partially resolved hyperfine interactions. The chemical shift was small for nickel compounds. The magnetic moment of the $^1/_2$ spin 67.3 keV state was +0.425 ± 0.043 nm, measured from the magnetic hyperfine interaction of an FeNi (1.5%) alloy. Quadrupole splitting of the $^5/_2$ state was observed in $(NH_4)_6[Ni_{IV}Mo_9O_{32}]$. (auth) (UK)

9395 SOLUBILITY OF METALS IN LIQUID SODIUM. Walker, R. A.; Pratt, J. N. Birmingham, Eng., Univ. of Birmingham, 1968. 169p.

Thesis.

The use of liquid metals in reactor cooling systems is reviewed and particular attention is given to the coolant sodium. The techniques employed and the results obtained in previous investigations of solubilities in liquid sodium are discussed, and the design and construction of an apparatus developed for the determination of solubilities in high purity liquid sodium are described. The solubilities of bismuth, copper, tellurium, and cobalt in high purity liquid sodium were investigated and results for the first three solutes are reported in the form of the equations log (atomic percent Bi) = 4.9999 – 4185.6/T, log (atomic percent Cu) = –0.4967 – 2016.1/T, and log (atomic percent Te) = 0.7502 – 1281.3/T where T represents the temperature in degrees Kelvin. The solubility of cobalt was found to be too low to be determinable by the experimental method used and no data are given for this solute. X-ray investigations of the phases which precipitated from solution during the solubility determinations showed that, for the systems sodium–bismuth, –copper, and –tellurium, the equilibrium phases were Na_3Bi, Cu, and Na_2Te, respectively. The lattice parameter of the compound Na_2Te was found to differ slightly from earlier reported values. The various attempts which have been made to rationalize solubility data are discussed, and a review of reported solubility data is presented in appendix form. These data have been critically examined in an effort to determine the principal factors governing solubilities in liquid metal systems. For the systems with sodium as solvent and the B sub-group elements as solutes, it appears that electronegativity effects are most important. (auth) (UK)

9396 THORIUM PHOSPHATE COMPOUNDS. Molodkin, A. K.; Petrov, K. I.; Balakaeva, T. A.; Kuchumova, A. N. (Inst. of General and Inorganic Chemistry, Moscow. Moscow Inst. of Fine Chemical Tech.). Zh. Neorg. Khim., 13: 3209-15(Dec. 1968). (In Russian).

Thorium phosphate compounds were prepared in aqueous solutions by reactions of thorium nitrate with phosphoric acid and alkali metal phosphates or ammonium phosphates. The thermal decomposition of the compounds was studied. Complete dehydration of thorium orthophosphate occurred at about 600°C. Compounds of the type $MeTh(PO_4)(OH)_2 \cdot NH_2O$, where Me is K or Na, lose water and they decompose to form thorium pyrophosphate. The absorption spectra of the compounds were studied. (tr-auth)

9397 REACTIONS OF URANYL OXALATES WITH FLUORIDE IONS. Shchelokov, R. N.; Belomestnykh, V. I. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 13: 3386-91(Dec. 1968). (In Russian).

The possibility of stairstep-like substitution of fluoride ions for oxalate groups in uranyl oxalates was studied. Intermediate compounds and thermal decomposition of the compounds were determined. (tr-auth)

9398 HALIDES OF THE LANTHANIDES AND ACTINIDES. Brown, D. London, John Wiley, 1968. 290p. 84s.

A review is presented under the following main headings: Introduction (valence states, special problems associated with the radioactive actinide elements, halogenating agents and dry atmosphere boxes); fluorides and oxyfluorides; chlorides and oxychlorides; bromides and oxybromides; iodides and oxyiodides.

Appendices give information on thermochemical properties, metal-halogen and metal-oxygen vibrational frequencies, and mixed halides of uranium and protactinium. (UK)

9399 HALIDES OF THE TRANSITION ELEMENTS: HALIDES OF THE SECOND AND THIRD ROW TRANSITION METALS. Canterford, J. H.; Colton, R. London, John Wiley and Sons, 1968. 429p. 120s.

A review is given of the halides of Re, Nb, Ta, Mo, W, Pd, Pt, Zr, Hf, Tc, Ru, Os, Rh, Ir, Ag, and Au, including trinuclear and hexameric compounds. (UK)

9400 CHEMICAL REACTIVITY OF SOME CYCLIC KETONES IN α-HYDROGEN EXCHANGE REACTION. Leshina, T. V.; Kim, A. M.; Mamaev, V. P.; Molin, Yu. N. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR. Inst. of Organic Chemistry, Novosibirsk, USSR). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ., 4: 814-21(Dec. 1967). (In Russian).

Acid-catalyzed α-hydrogen exchange reactions of cyclohexanone (I), α-cyanocyclohexanone (III), α-chlorocyclohexanone (II), α-tetralone (IV), acetophenone (V), 1(-p-toluenesulfono)-1,2,3,4-tetrahydroquinolone-4 (VI), 2-methyl-1,2,3,4-tetrahydroisoquinolone-4 (VII), indanone (VII), and chromanone-4 (IX) with deuteriotrifluoroacetic acid has been studied, using the NMR technique. Making first-order plots of the data obtained in the α-deuteration experiments straight lines would be obtained. First-order constants of reaction velocity were determined for ketones I to IX. From this data activation energies and pre-exponential factors for I to V and VIII were calculated. The reactivity of ketones in this reaction is decreased in the following order III ~ I > IV ~ VII ~ II ~ VI ~ VII > V ~ IX. It was found that the influence of substitutions on the acid-catalyzed α-hydrogen exchange reactions if very small. (auth)

9401 PLUTONIUM(IV) NITRATE COMPLEXES OF TRIPHENYLARSINE OXIDE AND TRIPHENYLPHOSPHINE OXIDE. Plymale, D. L. (Mound Lab., Miamisburg, Ohio). J. Inorg. Nucl. Chem., 31: 236-9(Jan. 1969).

The preparation and characterization of two plutonium-239 compounds isolated from the reaction of plutonium(IV) nitrate with triphenylarsine oxide and triphenylphosphine oxide are described. Plutonium(IV) nitrate combines with these ligands in molar ratios of 1:2. Infrared data were used to characterize these compounds. (UK)

9402 REACTION OF HYDROGEN WITH FILMS OF TITANIUM AND SCANDIUM ON VARIOUS METAL SUPPORTS. Rodin, A. M.; Grushina, V. V.; Kovba, L. M.; Trunov, V. K. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1854-7 (Nov. 1968). (In Russian).

The amount of hydrogen absorbed by films of titanium and scandium on supports of various metals depends on the support material and on the temperature. In the high-temperature region of treatment to saturation, only films on molybdenum supports were capable of absorbing hydrogen up to high atomic ratios. On nickel supports the metals form intermetallic compounds with the nickel and these do not react with hydrogen. It is assumed that the poor absorption of hydrogen by titanium and scandium films on other support materials is explained by intermetallic compound formation. (tr-auth)

9403 THERMAL STABILITY OF PRASEODYMIUM MONOPHOSPHIDE. Mironov, K. E.; Vasil'eva, I. G.; Mironov, Yu. I.; Prokhorova, N. M. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1869-73(Nov. 1968). (In Russian).

The process of thermal dissociation of praseodymium phosphide was studied in argon, hydrogen, and air at temperatures to 1450°C. Formation of the phase PrP_{1-x} was observed and the lattice parameter of the starting material was kept to the composition $PrP_{0.85}$ (on further loss of phosphorus the cubic structure was kept, but the lattice parameters decreased). In the presence of oxygen, oxygen-containing phosphorus compounds were formed. (tr-auth)

9404 STUDY OF THE VIBRATIONAL SPECTRA OF TWELVE ISOTOPIC SPECIES OF AUTOASSOCIATED ETHANOLS. Perchard, Jean-Pierre; Josien, Marie-Louise (Faculte des Sciences, Paris). J. Chim. Phys., 65: 1856-75(Oct. 1968). (In French).

Infrared spectra of twelve isotopic species of ethanol in liquid and solid states were examined in the 3000 to 500 cm^{-1} range. An assignment is proposed on the basis of isotopic substitutions and the comparison with the spectra of monomer alcohols. The couplings of the δ(COH) vibration are pointed out. The problems of the hydrogen bond in the ethanol crystal and of the rotational isomerism are discussed. (auth)

9405 STUDY OF THE VIBRATIONAL SPECTRA OF TWELVE ISOTOPIC SPECIES OF MONOMERIC ETHANOLS. Perchard, Jean-Pierre; Josien, Marie-Louise (Faculte des Sciences, Paris). J. Chim. Phys., 65: 1834-55(Oct. 1968). (In French).

Infrared spectra of twelve isotopic species of ethanol in the gaseous state and in diluted solution were examined in the 3000 to 500 cm^{-1} range. An assignment is proposed on the basis of the isotopic substitutions. Among other things it shows the evolution of the coupling of the δ(COH) vibration in relation with the isotopic species. The problem of rotational isomerism is discussed. (auth)

9406 KINETIC ISOTOPIC EFFECTS IN PROTOPHILIC ISOTOPIC EXCHANGE REACTIONS OF HYDROGEN IN CH-ACIDS WITH DIMETHYL SULFOXIDE. Shapiro, I. O.; Yakushin, F. S.; Romanskii, I. A.; Shatenshtein, A. I. (Inst. of Physical Chemistry, Moscow). Kinet. Katal., 9: 1011-15(1968). (In Russian).

Measurements were made of the kinetic isotopic effect in reactions of protophilic isotopic exchange of deuterium and tritium in diphenylmethane, thiophene, toluene, thioanisole, and diphenyl ether with dimethyl sulfoxide (DMSO) during catalysis by alkali metal tertbutylates. Analysis of experimental data (k_D/k_T = 1.1 to 1.5) does not agree with published data on the low kinetic isotope effect in the case of hydrogen exchange with DMSO. (tr-auth)

9407 HYDROGEN–DEUTERIUM EXCHANGE IN THE METHYL GROUP OF DIAMMINE-BIS-(ACETYLACETONE)ETHYLENEDIIMINE-COBALT(III) CHLORIDE IN DEUTERIUM OXIDE SOLUTION. Yoneda, Hayami (Wakayama Univ., Masagocho, Japan); Morimoto, Yukiyoshi. Bull. Chem. Soc. Jap., 41: 2544(Oct. 1968).

Proton magnetic resonance spectral studies on deuterium–hydrogen exchange in diammine-bis (acetylacetone)ethylenediiminecobalt(III) chloride, indexed as an ammonia and cobalt chloride complex of 4,4'-(ethylenedinitrilo)di-2-pentanone, dissolved in deuterium oxide are reported. Deuterium exchange in the CH and CH_3 groups is discussed. (J.G.B.)

9408 DETERMINATION OF THE STABILITY CONSTANTS OF SOME ACTINIDE COMPLEXES. I. CALCULATION OF STABILITY CONSTANTS FROM DISTRIBUTION MEASUREMENTS. Lahr, H. (Technische Hochschule, Brunswick); Knoch, W.; Liljenzin, J. O. Radiochim. Acta, 10: 113-16(Dec. 1968). (In German).

The evaluation of complex equilibria from distribution measurements is possible using suitable computer programs. The main features of a program based on the "pit-mapping" procedure by Sillén are discussed. A long chain amine was used as the extractant. A model for the extraction mechanism of actinide complexes from aqueous solutions is proposed. (auth)

9409 ON THE KINETICS OF THE REACTION OF Zr WITH O AT LOW PRESSURES AND HIGH TEMPERATURES. Nierlich, Jean; Paidassi, Jean (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. C, 1429-32(Nov. 25, 1968). (In French).

The change of weights of samples of zirconium, subjected in the α phase to the action of oxygen at low pressures (p_{O_2} = 2.10^{-4} to 1.10^{-3} torr), was determined precisely; its relation with the phenomena of formation and of growth of the superficial zirconia was established. The correlation observed between p_{O_2} and the kinetics of oxidation led to the conclusion that the limiting stage of the reaction under these conditions is the chemisorption of oxygen on the surface of the sample. (tr-auth)

9410 CHEMICAL AND KINETIC STUDY OF THE REACTION BETWEEN THIONYL CHLORIDE AND UF_6. Moncelon, Bernard; Kikindai, Tivadar (Ecole Centrale des Arts et Manufactures, Paris. CEN, Saclay, France). Compt. Rend., Ser. C, 267: 1485-8(Nov. 25, 1968). (In French).

Gaseous $SOCl_2$ reduces gaseous UF_6 at ordinary temperatures. The products obtained are β-uranium pentafluoride and thionyl fluoride. Thionyl chloride fluoride appears transiently and is not completely transformed in the absence of the hexafluoride. The reaction, followed by continuous reading of the pressure for different ratios of initial concentrations of $SOCl_2/UF_6$, is complete in 12 to 20 hours by following the conditions of the experiment. (tr-auth)

9411 DEUTERIUM VISCOSITY AT A CONSTANT DENSITY FROM 20.4°K TO 300°K. Rudenko, N. S.; Slyusar, V. P. (Kharkov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 13: 1857-61 (1968). (In Russian).

A temperature dependence of the viscosity factor of normal deuterium at a constant density was investigated. Dependences of viscosity on pressure and density at a constant temperature were obtained from results of the investigation. Measurements were carried out at densities reaching 0.1706 g/cm^3 at 20.4 to 300°K. The pressure obtained in a viscosimeter reached 2800 atm at the maximal density. Two viscosity mechanisms were detected, liquid

and gaseous for the densities $\rho > 2\ \rho_{cr}$ and only gaseous one for the densities $\rho < 2\rho_{cr}$. On the basis of the Enskog theory, effective diameters of deuterium molecules were calculated depending on temperature. (auth)

9412 RHENIUM AND TECHNETIUM(VI) AND MESO-(VII) SPECIES. Majumdar, S. K.; Pacer, R. A.; Rulfs, C. L. (Univ. of Michigan, Ann Arbor). J. Inorg. Nucl. Chem., 31: 33-41(Jan. 1969).

A spectrophotometric study showed that less than 35 percent of normal perrhenate converts to a meso form in 15 M base, and $K_f \sim 0.1$. This species absorbs at 260 mμ (ϵ = 6,400) and near 310 mμ ($\epsilon \sim 1{,}400$), overlapping the normal perrhenate features. Reflectance spectra on an isolable barium salt, $Ba_3(ReO_5)_2$, confirmed this resolution of the curve components. The variation of the barium salt solubility with concentration of aqueous hydroxide ion was consistent with the equilibrium deduced from spectrophotometry. Hydration was found for this salt, and did not require the postulation of a dimeric form (to maintain 6-coordination); nor did this postulate seem to fit the equilibrium data or the ir absorption. No detectable amount of a comparable mesopertechnetate species was found in aqueous media of any alkalinity. However, pertechnetate fused in sodium hydroxide gave new absorption at 345, 420, and (~570) mμ (of relative ϵ ca. 8/4/1), which was probably due to meso (or ortho) species. Attempts to isolate a (VI) sale, $BaTcO_4$, from hydrazine-reduced (VII) T_c in alkaline aqueous media resulted in mixtures. Disproportionation of the intermediate state forms TcO_2, and incidental $BaCO_3$, gave "products" of high Tc/Ba ratio. The red intermediate is more likely to be a Tc(V) species. (auth) (UK)

9413 INFRARED SPECTRUM AND STRUCTURE OF LITHIUM HEXAFLUOROACETYLACETONATE–TETRAMETHYLETHYLENEDIAMINE ADDUCT. Shobatake, Kosuke; Nakamoto, Kazuo (Illinois Inst. of Tech., Chicago). J. Chem. Phys., 49: 4792-6 (Dec. 1, 1968).

The infrared spectra of monomeric ^{7}Li hexafluoroacetylacetonate–tetramethylethylenediamine adduct and its ^{6}Li analog have been obtained from 4000 to 90 cm^{-1} in benzene solution. Normal-coordinate analysis has been carried out to estimate the Li–O stretching force constant as well as to assign the Li–O stretching modes. The results indicate that two bands at 544 and 527 cm^{-1} of the ^{7}Li adduct are due to the Li–O stretching modes. The corresponding Li–O stretching force constant is estimated to be 0.52 mdyn/Å. (auth)

9414 KINETIC STUDIES IN ETHYLENE POLYMERIZATION WITH ZIEGLER TYPE CATALYSTS. VI. CHARACTERIZATION OF CATALYST SITES BY POLYMERIZATION EXPERIMENTS IN THE PRESENCE OF DEUTERIUM. Schindler, A. (Research Triangle Inst., Research Triangle Park, N. C.). Makromol. Chem., 118: 1-18(Nov. 19, 1968).

Ethylene polymerization in the presence of deuterium was investigated with the four catalyst systems resulting from Et_3Al and Et_2AlCl in combination with either $TiCl_4$ or $TiCl_3$. From the effect of catalyst ratio on the kind and the amount of deuterated products formed, the existence of three kinds of titanium sites could be inferred. An H–D-exchange reaction involving the β-hydrogen of the growing chain was found to be characteristic for chain growth on Ti(IV) sites. The inactivity of BuLi or Et_2Zn systems in such exchange reactions implied the existence of bimetallic complexes in alkylaluminum systems. The exclusive formation of CH_2D groups in the polymer by a transfer reaction was found to be characteristic for chain growth on Ti(III) sites. The occurrence of an H–D-exchange reaction involving the monomer and the formation of deuterated ethanes was assigned to the presence of polymerization inactive titanium hydride sites, formed at high catalyst ratios. (auth)

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Refer also to abstracts 9306, 9359, 9360, 9390, 10971, and 11017.

9415 (ANL-7485) BUILDUP OF RADIOACTIVE PRODUCTS IN THERMAL REACTORS. II. ^{226}Ra TARGETS. Stewart, D. C.; Macias, E. S.; Basile, L. J.; Milsted, J. (Argonne National Lab., Ill.). Sept. 1968. Contract W-31-109-Eng-38. 17p. Dep. CFSTI.

The buildup of isotopic products from irradiation of ^{226}Ra targets in a thermal neutron flux is reported. Results of calculations are presented in tables. Yields of ^{227}Ac were determined. (M.C.G.)

9416 (BNL-12114) REMOVAL OF IRON FROM ACID MINE DRAINAGE WASTE WITH THE AID OF HIGH ENERGY RADIATION. PART II. Steinberg, M.; Pruzansky, J.; Jefferson, L. R.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y.). Dec. 1967. 17p. (CONF-680536-1). Dep. CFSTI.

From Coal Industry Advisory Committee Meeting to ORSANCO, Pittsburgh, Pa.

Experimental results on the ^{60}Co gamma radiation oxidation and removal of ferrous iron from Fulton Borehole Acid Mine drainage (488 ppM Fe^{2+} and pH = 3.35) are presented. At ambient temperature (25°C) with limestone neutralized and aerated solutions, chain oxidation yields with G values ranging into the hundreds (up to 285) were obtained. G values and rates of Fe^{2+} removal decreased with decreasing temperatures and at field temperatures (10°C), the incremental G value and rate compared to the unirradiated controls indicated a nonchain mechanism. At high intensity (3.5 megarads/hr), a G value of 12 and a rate of removal 20 times higher than the control with relatively little affect of temperature was obtained. Increasing the pH and aeration increased the radiation yield for Fe^{2+} removal. There was no significant effect of such additives as formic acid, Cu^{2+}, H_3PO_4, or NaOCl on the radiation yields. Hydrogen peroxide reacted quantitatively with Fe^{2+} with no radiation chain effect. Preliminary experiments for a mechanically stirred system with a large excess of $CaCO_3$ indicated significant improvement in both the irradiated and nonirradiated control at 11°C. A maximum rate of 71 ppM/min at a G value of 20 was obtained at a radiation intensity of 3.5 Mrads/hr. The process economic factors for the radiation, chemical, uv, and neutralization and air oxidation processes are discussed and evaluated. The maximum concentration of Fe^{2+} that can be removed for a treatment cost of $0.10/1000 gal is twice the value of G, (the radiation yield). The limestone neutralization removal of Fe^{2+} is most competitive if rates in the order of 10 ppM/min or more can be obtained. (auth)

9417 (BNL-12115) REMOVAL OF IRON FROM ACID MINE WITH THE AID OF HIGH ENERGY RADIATION. PART III. Steinberg, M.; Pruzansky, J.; Jefferson, L. R.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y.). Jan. 1968. 11p. (CONF-680536-2). Dep. CFSTI.

From Coal Industry Advisory Committee Meeting to ORSANCO, Pittsburgh, Pa.

Experimental data are presented on the rate of oxidation and removal of ferrous iron from Fulton Borehole acid mine drainage, an iron-containing (350 ppM) acid water (pH = 3.1) by mechanical agitation and aeration with a large excess of crushed limestone and with the effect of radiation. It appears that relatively high rates of Fe^{2+} iron removal, up to 83.5 ppM/min, can be obtained with limestone neutralization alone at a pH ≤6.5 at a temperature of 10°C. Particle size, degree of agitation, mass ratio of limestone to mine water appear to be several important variables in obtaining high removal and neutralization rates. Whereas ^{60}Co gamma radiation can yield high rates and high chain G values for Fe^{2+} removal in the absence of vigorous agitation, the incremental contribution of radiation decreases as the rate with neutralization increases by means of excess limestone and mechanical stirring. An economic evaluation indicates that it would be difficult to justify a radiation process in view of the rate of iron removal that was observed with limestone neutralization. (auth)

9418 (COO-1580-4) CONTROLLED POLYMERIZATION OF ADSORBED MONOMERS. Technical Progress Report. Livingston, H. K. (Wayne State Univ., Detroit, Mich. Dept. of Chemistry). Dec. 27, 1968. 30p. Dep. CFSTI.

Research progress is reported on: adsorption of monomers from vapor phase onto solids, polymerization at gas/solid interface, and adsorption at liquid interfaces. (M.C.G.)

9419 (COO-1653-15) THE EFFECTS OF IONIZING RADIATION ON COLLOIDS. Final Report, May 1964–November 1966. (Unidynamics, Phoenix, Ariz. Research Dept.). Nov. 1967. Contract AT(29-2)-1653. 85p. Dep. CFSTI.

A preliminary study was made of the effects of ionizing radiation on colloidal systems of special interest to various industries. Program goals were: disclosure of radiation effects that might have industrial applications and selection of areas best suited for further, more critical study. Three colloidal systems and a class of chemicals used industrially to prepare emulsions were evaluated. The effects of gamma radiation on polyoxyethylene resins seem best explained by the assumption that two types of reactions, (chain scission and crosslinking and/or chain building) occur simultaneously, but at rates that are dependent on total dose, initial molecular weight and other variables. The scission reaction appears to be of only minor importance in the case of lower-molecular-weight polymers. However, it is rapid in the higher-molecular-weight polymers. With high-molecular-weight resins, chain scission appears to be independent of dose rate. Crosslinking is characterized by a long induction period prior to manifestation of the effect, and the critical dose is dependent on initial chain length and concentration. It is possible to suppress crosslinking by introduction of oxygen prior to or during irradiation. The continuing drop in viscosity in the presence of oxygen is clear evidence of continued scission. This suggests that the radicals

necessary for crosslinking are scavenged by that gas. Once initiated, crosslinking is rapid, confirming the supposition that a specific concentration of certain scission products is necessary to trigger and sustain the reaction. Exposure to ionizing radiation results in changes in the basic properties of a model aqueous colloid system. The most significant change in those properties studied was the relative stability of irradiated sols. Data indicate that it is also possible to increase the sedimentation rate of an aqueous colloidal suspension. It is necessary to irradiate the suspensions in the presence of the flocculating agent to obtain this decreased stability, however, and data show that organic flocculants are ineffective after irradiation, presumably because of the radiation damage incurred. Test data indicate that surfactant-free oil and water emulsions can be stabilized by irradiation. The stabilization occurs only when emulsification and irradiation are performed simultaneously, suggesting that a hydrophilic site is formed on one end of the oil molecule by reaction with radiolytic products in the water. (auth)

9420 (GA–8872) PULSE RADIOLYSIS STUDY OF PROTECTION OF PYRIMIDINE BASE COMPONENTS OF NUCLEIC ACID BY AMINOTHIOLS IN AQUEOUS SOLUTION. Annual Summary Report, June 22, 1967–June 21, 1968. Theard, L. P.; Peterson, F. C. (Gulf General Atomic, Inc., San Diego, Calif.). Sept. 6, 1968. Contract AT(04-3)-167. 111p. Dep. CFSTI.

Studies were made of the mechanisms by which ionizing radiation induces chemical transformation of purine and pyrimidine base components of nucleic acid and aminothiols present in dilute concentration in aqueous solutions. Results are presented for thymine, cysteine, cystine, DNA, and mixtures of DNA and cysteine. (M.C.G.)

9421 (JLI–3655-200) THE RADIATION CHEMICAL REACTIONS OF OLEFINS WITH METHANETHIOL AND WITH METHYLSILANES AND OF DIMETHYLAMINE. Final Report. Howard, B. Y.; Koski, W. S. (Johnston Labs., Inc., Baltimore, Md.). [1967]. Contract AT(30-1)-3655. 92p. Dep. CFSTI.

The effects of β- and γ-irradiation on several chemical systems were examined. Mixtures of ethylene with methylsilane and with dimethylsilane were irradiated, and the G values of the 1:1 and 1:2 telomers determined. Other silane systems studied more briefly were methylsilane and methane, methylsilane alone, methylsilane and water, methylsilane and ammonia, dimethylsilane and dimethylamine, dimethylsilane and isobutylene, and ethylene and methyl- and dimethylchlorosilane. Pure dimethylamine was irradiated and the largest product was N,N,N′,N′-tetramethylmethylenediamine, with G values of 2.5 when oxygen was excluded from the reaction. The G value is independent of temperature, dose rate, and pressure. The reaction is catalysed by fresh metallic surfaces, small amounts of oxygen and is not affected by small amounts of NO. The proposed mechanism is an ion–molecule reaction. Studies were done on the effects of other methylamines and ammonia on the reaction, as well as 1,3,5-trimethylhexahydro-sym-triazine and various potentially catalytic surfaces. Methanol and ethylene were irradiated in the gas phase at temperatures from 150 to 285°C. and pressures from 27 to 33 atmospheres. The only products found were those of the irradiation of ethylene alone. It was concluded that higher temperatures and pressures would probably have to be used in order to obtain the desired higher alcohol and ether products. Methanethiol and ethylene were irradiated in the gas phase. The major product is methyl ethyl sulfide, the 1:1 telomer. The G value of the product varies inversely with the temperature, directly with the pressure, directly with the ethylene and methanethiol concentrations and inversely with the dose rate. Small percentages of the free radical scavengers, NO and O_2, prevent the reaction, which is thus assumed to be a free radical reaction. A mechanism for the reaction is proposed and discussed in the light of the experimental results. The reactions of methanethiol with propylene, cis-butene-2, trans-butene-2, isobutylene, 1-butene, cyclopentene, and cyclohexene were also studied. (auth)

9422 (NYO–2499-26) EFFECTS OF MERCAPTANS AND DISULFIDES ON PHOTOCHEMICAL AND HIGH ENERGY RADIATION INDUCED REACTIONS. Progress Report. Cohen, Saul G. (Brandeis Univ., Waltham, Mass. Dept. of Chemistry). Nov. 1, 1968. Contract AT(30-1)-2499. 25p. Dep. CFSTI.

Photoreduction of aromatic ketones by primary, secondary, and tertiary amines in aqueous-organic media was studied. Studies on the photoreduction of aminobenzophenones by organic reducing agents, particularly tertiary amines in nonpolar media, were continued. Additional work was done on the photochemistry of the acetone–benzhydrol–2-mercaptomesitylene system. Effects of mercaptans on irradiation of dilute aqueous solutions of organic compounds are reported. The γ-radioinduced conversion of aqueous 2-propanol to acetone was found to be retarded by aliphatic mercaptans, while the conversion of aqueous acetone to 2-propanol was accelerated by mercaptans. (J.G.B.)

9423 (ORO–3781-2) INVESTIGATION OF GAMMA-RAY INDUCED POLYMER FORMATION IN THE CARBORANES. Annual Progress Report. Klingen, Theodore J. (Mississippi Univ., University. Dept. of Chemistry). Dec. 1, 1968. Contract AT(40-1)-3781. 9p. Dep. CFSTI.

Polymeric products were not obtained in the γ-radiolysis of solid o-carborane and o-carborane in benzene solution. Properties of the product formed in the γ-radioinduced polymerization of vinyl-o-carborane are reported. (J.G.B.)

9424 (RFP–1089) RADIOLYSIS OF GASEOUS AMMONIA. Kazanjian, Armen R.; Brown, Alan K. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Nov. 22, 1968. Contract AT(29-1)-1106. 7p. Dep. CFSTI.

Ammonia was irradiated by α particles and γ rays, and G values for ammonia decomposition were 3.5 ± 0.2 for α radiolysis and 4.0 ± 0.2 for γ radiolysis. The difference in yields can be attributed either to the difference in linear energy transfer (LET) or the difference in radiation intensity, both of which are unusual effects in gas phase radiolysis. (auth)

9425 (TID–24870) THE CHEMISTRY OF SEVERAL HYDROXOCHLOROPLATINATES(IV) AND THEIR USE IN THE ISOLATION OF CARRIER FREE ^{197}Pt. Armento, W. Joseph (Georgia Inst. of Tech., Atlanta). June 1968. 331p. Dep. CFSTI.

Thesis.

To carry out the Szilard–Chalmers reaction, platinum metal was irradiated with neutrons. The hexachloroplatinate(IV), $PtCl_6^{=}$, complex was prepared and allowed to remain in an aqueous solution for 8 to 24 hr with no excess of chloride ion present. The daughter was then separated as a complex of the form $Pt(IV)Cl_x(OH)_{6-x}^{=}$ where x = 0 to 4. The first continuous separation method used was ascending paper chromatography. A column packed with paper cellulose was also tried, using the same solvent combination. The separation of ^{197g}Pt is described. (M.C.G.)

9426 (UCRL–18216, pp 99-112) PHOTOCHEMISTRY AND RADIATION CHEMISTRY. (California Univ., Berkeley. Lawrence Radiation Lab.).

BENZENE — radiation effects on, yields of labeled products from recoil carbon-14 atom and ion
CARBON-14 — effects of recoil atoms and ions of, on benzene, yields of labeled products from
CHOLINE — chloride, radiolysis of crystalline, ESR spectral studies on γ and proton
GAMMA RADIATION — effects on crystalline choline chloride, ESR spectral studies on
PROTONS — effects on crystalline choline chloride, ESR spectral studies on (P.C.H.)

9427 EFFECT OF TEMPERATURE ON SATURATION CURRENTS IN GAS PHASE RADIOLYSIS CELLS: THE CONDUCTANCE OF PYREX AND OTHER CELL MATERIALS. Byrtus, R. M.; Freeman, G. R. (Univ. of Alberta, Edmonton). Can. J. Chem., 47: 191-4(Jan. 15, 1969).

When gas-filled Pyrex cells were heated above about 50°C, the saturation currents obtained in a γ radiation field apparently decreased. At temperatures above 100°C good saturation currents were not obtained. At temperatures below 50°C the conductance of Pyrex was negligible, and "true" saturation currents were measured. At temperatures greater than 50°C the Pyrex conducted appreciably, so the total current flowing in the circuit was appreciably greater than the gas phase saturation current (absorbed dose rate 10^{10} to 10^{13} eV/ml s). If the outer surface of the cell was grounded, for example by ionized air, part of the current bypassed the measuring ammeter, thereby decreasing the "apparent" saturation current. The magnitude of the temperature effect was greatly decreased by wrapping the cell with teflon tape, thereby insulating it from the ionized air. The effect of temperature on apparent saturation currents measured in quartz cells was much smaller than that in Pyrex cells, because the conductance of quartz was much less than that of Pyrex at temperatures above 50°C. When a metal cell that contains a Pyrex insulator between the electrodes is used, the temperature of the Pyrex should be kept below about 50°C. (auth) (Canada)

9428 TRENDS IN RADIATION POLYMERIZATION. Potter, R. C. (Univ., Cologne); Schneider, Christel; Ryska, M.; Hummel, D. O. Angew. Chem. Int. Ed. Engl., 7: 845-56(Nov. 1968).

Previously it was generally assumed that high energy radiation could only initiate radical polymerization in solutions of monomers. However, examples of radioinduced polymerization have recently become known that proceed via an ionic mechanism. Thus,

solutions of a monomer can be polymerized ionically, preferably in the presence of a solid, at low temperatures. Surprisingly, this may also be accomplished with ultra-pure, mainly anhydrous systems, even at room temperature. The nature of the ions has not yet been fully elucidated. (auth)

9429 ON THE STRUCTURE AND PROPERTIES OF POLYAMIDES. XXXI. THE SECONDARY RELAXATION PROCESS OF ALKALINE POLYCAPROLACTAM IRRADIATED WITH γ RAYS OF ^{60}Co. Kolarik, J. (Inst. of Macromolecular Chemistry, Prague). Collect. Czech. Chem. Commun., 33: 3384-6(Oct, 1968).

Samples of alkaline polycaprolactam were irradiated with ^{60}Co gamma rays at room temperature to doses of 12, 100, and 450 Mrad. A stable secondary (β) relaxation process maximum was observed, which did not disappear on annealing. It was concluded that this is due to the effect of low-molecular-weight compounds arising from the degradation reactions in the course of the irradiation. (M.C.G.)

9430 THE PROTECTIVE ACTION OF PROPYL GALLATE IN THE RADIOLYSIS OF AQUEOUS DNA SOLUTIONS. Nazhdimiddinova, M. T.; Sharpatyi, V. A.; Kruglyakova, K. E.; Emanuel, N. M. Dokl. Akad. Nauk SSSR, 182: 1354-7(Oct. 21, 1968). (In Russian).

The mechanism of inhibiting effects of propyl gallate (PG) in low-temperature radiolysis of DNA was investigated. It was assumed that the paramagnetic particle recorded in frozen DNA and PG solutions was a radical formed during irradiations as a result of spallation of H from the phenol OH group. Two series of experiments were initiated in order to confirm the above assumption. In one of the experiments the specimens irradiated at −196° were heated, and in the other the specimens were irradiated at various temperatures. It was found that with specimen temperature rise from −196 to −160°C the OH radicals disappeared while the concentration of R_{DNA} and R_{PG}, as a whole, did not increase. It was assumed that with heating the stabilized OH radicals do not react with dissolved DNA and PG. The PG acted as a donor of the hydrogen atom in hydroxyl group altering the initial damage in the reaction R + H In = RH + In. Tabulated data are given on the yield of radicals in frozen irradiated hydrous solutions of DNA, propyl gallate, and parabenzoquinone. (R.V.J.)

9431 EFFECT OF GAMMA IRRADIATION ON THE ELECTRON WORK FUNCTION FOR THE SURFACE OF AN INDUSTRIAL SILVER CATALYST UNDER AN OXYGEN OR ETHYLENE ATMOSPHERE AT 20° AND 120°C. Minc, Stefan; Siejka, Juliusz (Inst. of Nuclear Research, Warsaw). Nukleonika, 13: 1137-55(1968).

The effect of γ radiation on the electron work function for an industrial silver catalyst commonly used in the process of oxidation of ethylene to ethylene oxide was studied. The irradiation was carried out in vacuo, in an oxygen atmosphere, and in ethylene at 20°C and 120°C. It was found that irradiation at 20°C influences strongly the catalyst–oxygen system, but does not influence to a larger extent the catalyst–ethylene system. At 120°C the inverse effect was observed. An explanation of results is proposed. (auth)

9432 RADIOLYSIS OF CYCLOHEXANE IN THE PRESENCE OF NITRIC OXIDE. Horacek, K.; Getoff, N. (Max-Planck-Institut fuer Kohlenforschung, Muelheim, Ger.). Int. J. Appl. Radiat. Isotop., 20: 43-51(Jan. 1969). (In German).

Radiolysis of the cyclohexane–NO system by ^{60}Co γ rays and 2 MeV electrons was studied as a function of radiation dose and dose rate. It was established that the yields of the radiolytic products from pure cyclohexane (hydrogen, cyclohexene, and bicyclohexyl) diminished, whereas the yields of the nitrogen containing derivatives increased. The initial G-values (G_i) of the products obtained by irradiation with 2 MeV electrons of cyclohexane under continuous bubbling NO through the solution were: G_i (nitrosocyclohexane) = 0.45, G_i (cyclohexanone oxime) = 0.15, G_i (cyclohexylnitrate) = 0.50, G_i (nitrocyclohexane) = 0.10, G_i (bicyclohexyl) = 0.60, G_i (cyclohexanol) = 0.35, and G_i (cyclohexanone) = 0.50. At a dose of 3.9×10^{21} eV/ml G (cyclohexylnitrite) = 0.20, G (adipic acid) = 0.10, and a mixture of polymers with a G-value of 1.4 could be determined. When irradiating the cyclohexane–NO system with ^{60}Co γ rays under stationary conditions $G_i(H_2) = 4.3$ and $G_i(N_2) = 3.6$, obtained as non-condensible gases at −196°C, could be also measured. A reaction mechanism for the radiolytic process is proposed. (auth) (UK)

9433 APPEARANCE OF A RADICAL SPECIES WITH 13 EQUIVALENT PROTONS AMONG THE RADIOLYSIS PRODUCTS OF A DURENE MONOCRYSTAL. Heurtaux, Jacques; Martin-Bouyer, Michel (Institut d'Etudes Nucleaires, Algiers). Compt. Rend., Ser. A and B., 267: 629-31(Sept. 30, 1968). (In French).

Among the EPR spectra from radiolytic products of durene, a spectrum characteristic of a radical species with 13 equivalent protons was observed. The adjustment of a theoretical curve by using the binomial coefficients gives a result satisfying in the hypothesis of the lines having a Lorentz form. (tr-auth)

9434 LIFETIME OF CHARGED SPECIES IN IRRADIATED DIELECTRIC LIQUIDS. Hummel, A. (Reactor Inst., Delft, Netherlands). J. Chem. Phys., 49: 4840-4(Dec. 1, 1968).

The distribution of lifetimes of the charged species formed in cyclohexane by high-energy radiation is calculated using the experimental results on the number of these species reacting with solutes as a function of the concentration of the solutes. The time in which half of the ions recombine, when no reaction with a solute takes place, is 6×10^{-10} sec. Due to the fact that the diffusion coefficient of the negative entity in cyclohexane at room temperature is very large (2.5×10^{-4} cm^2 sec^{-1}), scavenging of this entity increases the lifetime of the ions considerably. The effect of scavenging of the negative entity on the lifetime distribution is calculated. At large concentrations of α-chlorotoluene the lifetimes of the ions are increased by a factor of 16, approximately. The rate constant for the reaction of the negative entity with α-chlorotoluene at room temperature was estimated at 4×10^{-11} cm^3 sec^{-1}. (auth)

9435 REACTIVITY OF OH AND O^- IN THE RADIOLYSIS OF AQUEOUS SOLUTIONS. Hughes, G.; Makada, H. A. (Univ. of Liverpool). Trans. Faraday Soc., 64: 3276-81(Dec. 1968).

2-Propanol was used as a reference solute to determine the relative reactivities of the hydroxyl radical in the radiolysis of aqueous solutions. Ionic strength effects confirm that in alkaline solution its ionized form O^- is the significant reaction intermediate, and it is possible to compare the reactivities of both species. O^- is much less reactive in addition reactions and electron transfer reactions with negative ions though it is equally reactive in abstracting hydrogen atoms. The effect of pH on the oxidizing radical yield is discussed. (auth) (UK)

9436 CHEMICAL PROCESSES FOLLOWING NEUTRON CAPTURE IN TETRAMETHYLSILANE. Snediker, David K.; Miller, Warren W. (Pennsylvania State Univ., University Park). Radiochim. Acta, 10: 30-3(1968).

The chemical consequences of neutron capture into silicon in liquid tetramethylsilane were studied by gas chromatographic separation of products produced on neutron irradiation. The radioactivity of the chromatograph effluent, detected with a G-M counter, was counted with a multichannel analyzer operating in the multiscaler mode, giving a histogram that could be correlated with the chromatograph detector. From data on variation of product yield caused by scavenger, radiolysis, and change of phase, the effects of caging and the importance of tertiary radical formation are deduced. Uniquely high yields of dimeric products are observed in this case. (auth)

9437 RADIOLYSIS OF AROMATIC HYDROCARBONS IN THE PRESENCE OF NITROGEN OXIDE. Horacek, K.; Getoff, N. (Max-Planck-Institut fuer Kohlenforschung, Muelheim, Ger.). Int. J. Appl. Radiat. Isotop., 20: 53-60(Jan. 1969). (In German).

The radiolysis of benzene, toluene, cumene, tetralin, and indan was investigated in the presence of NO under the influence of ^{60}Co γ rays and 2-MeV electrons, respectively. The following yields were found for the main products of the benzene–NO system: biphenyl ($G_A = 0.08$), nitrobenzene ($G_A = 0.024$), nitrogen ($G_A = 2.1$), hydrogen ($G_A = 0.02$), apart from small amounts of phenylcyclohexadiene, p-terphenyl, phenol, nitrosobenzene, and nitrogen-containing polymers. The toluene–NO system yielded: benzyl nitrate ($G_A = 0.28$), bibenzyl ($G_A = 0.07$), benzaldehyde ($G_A = 0.22$) and, as byproducts, dimethylbiphenyl, benzylmethylcyclohexadiene, benzyl alcohol, benzoic acid, and nitrogen-containing polymers (G = 1.1). By irradiating the cumene–NO system the following were formed: α-nitrocumene, cumylnitrate, acetophenone, and polymers. In the mixture obtained from the tetralin–NO system the following were identified: nitrotetralin, nitrate ester of tetralol, and tetralone. 3-Nitroindene was isolated from the mixture of products of the indan–NO system. (auth) (UK)

9438 POLYMER PRODUCTION IN THE γ RADIOLYSIS OF METHANE IN LIQUID ARGON. Hamlet, Peter; Moss, Jefferey; Mittal, Jai P.; Libby, W. F. (Univ. of California, Los Angeles). J. Amer. Chem. Soc., 91: 258-60(Jan. 15, 1969).

The γ radiolysis of methane produces a polymer which in the condensed phase has an average molecular formula $C_{20}H_{40}$. An attempt to study the mechanism was made by using the ionization caused by electron transfer from methane to argon ions in liquid argon. The γ radiolysis of liquid argon–methane solutions showed that in mixtures containing as little as 0.15 mole % methane, a polymer averaging $C_{22}H_{42}$ was produced with a G value 11 times that for the polymer from pure methane. This G value is calculated on total energy absorbed by the sample. It is suggested that the polymer is formed by condensation of the dense blob of methane

fragments which could be formed by Auger electrons emitted following inner-shell ionization. This ionization would be highly localized. (auth)

9439 REACTIONS OF RECOIL CARBON ATOMS IN METHANOL AND ETHANOL. Palino, Gerard F.; Voigt, Adolf F. (Ames Lab., Iowa). J. Amer. Chem. Soc., 91: 242-50(Jan. 15, 1969).

Carbon-11 was produced by the reaction $^{12}C(\gamma,n)^{11}C$ in liquid methanol and ethanol, and the labeled products were separated and determined by radio-gas chromatography. A wide variety of products was observed from both alcohols. In the case of methanol mechanisms are proposed for their formation on the basis of the effect of change in dose and presence of I_2 or DPPH scavenger. Without scavenger many products result from reaction of the ^{11}C-containing intermediates with radicals observed in the radiation chemistry of methanol, particularly the hydroxy methyl radical, the hydrogen atom, and the solvated electron. Iodine scavenger effectively removes these radicals, and the product distribution can be explained on the basis of reactions of ^{11}C, ^{11}CH, and $^{11}CH_2$ with the C–H and O–H bonds and of ^{11}C with a lone electron pair on oxygen. Iodine enters the reaction path by competition with the radiation-produced radicals, removing them and in their place reacting with the ^{11}C-containing intermediates. In several cases the products of these reactions react further with methanol to produce dialkoxyalkanes. The study of the ethanol system was less intensive; mechanisms proposed for this system are similar to those for methanol. (auth)

9440 CHEMICAL EFFECTS OF NUCLEAR REACTIONS IN DOPED COMPOUNDS. I. POTASSIUM CHROMATE DOPED WITH BARIUM. Costea, T.; Podeanu, Georgeta (Institut de Physique Atomique, Bucharest. Centre d'Etudes Nucleaires-Saclay, Gif-sur-Yvette, France). Radiochim. Acta, 10: 53-7(1968). (In French).

Samples of K_2CrO_4 doped with barium ions were γ-irradiated in a reactor and thermally annealed afterwards. The activation energy was found to be higher in samples irradiated at lower doses. Furthermore, the activation energy decreases in presence of crystal defects in form of incorporated barium ions. The decrease of the activation energy as a function of the doping and the γ-dose is discussed in terms of oxidation reactions involving recoil species. (auth)

9441 DETERMINATION OF THE STRUCTURE OF POLY-(VINYLCHLORIDE)-STYRENE GRAFT COPOLYMERS BY FRACTIONATION. Langner, Heinz (Institut fuer Metallphysik und Reinstmetalle, Dresden). Makromol. Chem., 119: 37-49(Dec. 6, 1968). (In German).

The structure of poly(vinylchloride)–styrene graft copolymers prepared by radiation chemical methods was studied. By means of the solution fractionation according to Fuchs [O. Fuchs, Ber. Bunsenges. Physik. Chem., 70: 267(1966)], data are obtained about the distribution function of the graft products. By the choice of suitable solvent–precipitant combinations, qualitative results about the chemical heterogeneity of the products were obtained. A proposal of Cantow and Fuchs [H. J. Cantow and O. Fuchs, Makromolekulare Chem., 83: 244(1965)] for the mathematical description of chemically heterogeneous substances was applied to graft copolymers. (auth)

9442 ISOLATION OF ^{242}Cm FROM NEUTRON-IRRADIATED ^{241}Am. Hoehlein, G.; Born, H. J.; Weinlaender, W. (Technische Hochschule, Munich). Radiochim. Acta, 10: 85-91(1968). (In German).

A process for isolation of ^{242}Cm in the 100-Ci range was developed and tested. The Cm is separated from Am, Pu, and the fission products on cation exchangers. The trivalent actinides and lanthanides are first absorbed on an exchanger column and Ru, Zr, Nb, and tetravalent Pu are eluted as sulfato and oxalato complexes. Rare earths, trivalent Pu, Am, and Cm are then separated on a larger column by an automatic p_H-gradient elution technique with α-hydroxyisobutyric acid as eluent. 91.6% of the ^{242}Cm are isolated with a purity of 98.5%. The separation was performed in presence of methanol in order to reduce the radiolytic formation of gas. The results show that ^{242}Cm can be eluted on the mg scale on sulfonated polystyrene resins without appreciable disturbance of the separation by the high intensity of α radiation. (auth)

9443 PRODUCTION OF ^{45}Ti BY (γ,n) REACTIONS. Elias, H.; Bernhard, H. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta, 10: 109-10(1968). (In German).

Titanium dioxide targets were irradiated with bremsstrahlung in an electron accelerator. ^{45}Ti was produced by bremsstrahlung reactions (γ,n) with scandium isotopes that were produced by bremsstrahlung reactions (γ,p) with the original titanium isotopes. The scandium was separated from the titanium dioxide target by ion exchange. (M.C.G.)

9444 KINETICS OF RADIOINDUCED ISOTOPIC EXCHANGE IN THE SYSTEM IODOBENZENE–IODINE–BENZENE. Riess, R.; Elias, H. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta, 10: 110(1968). (In German).

Gamma-induced iodine-131 exchange in the system iodine–iodobenzene was studied. (M.C.G.)

9445 REACTIONS OF TRITIUM RECOIL ATOMS IN LIQUID AROMATIC AND ALIPHATIC HYDROCARBONS AND THEIR MIXTURES. Sokolowska, A. (Inst. of Nuclear Research, Warsaw). Radiochim. Acta, 10: 44-9(1968).

The chemical reactions of recoil tritium atoms from $^6Li(n,\alpha)^3H$ were studied in some liquid aromatic and aliphatic hydrocarbons. It was found that the significant differences in HT/RT ratio between the aromatic and aliphatic hydrocarbons should be attributed to both the increase of yield of substitution products and decrease of HT yield in aromatic molecules comparing with the aliphatic molecules. Studies on reactions of recoil tritium atoms in some mixed liquid systems (benzene–n-hexane, benzene–n-heptane, toluene–cyclohexane) confirmed the observation made previously on benzene–cyclohexane mixture that the yields of substitution products are linearly proportional to the mole fraction of each component. (auth)

9446 CHEMICAL EFFECTS OF GAMMA IRRADIATION ON ^{204}Tl INCORPORATED IN KCl CRYSTALS. Butterworth, John S. (Frankford Arsenal, Philadelphia); Harbottle, Garman. Radiochim. Acta, 10: 57-64(1968).

The γ-induced changes in the chemical state of $^{204}Tl^+$ ions, incorporated in KCl crystals, was studied by a combination of optical and radiochemical measurements. It was found that a substantial fraction of the labeled Tl^+ ions are converted by room-temperature irradiation into a form which follows Tl(III) on dissolution. The experimental results are interpreted in terms of oxidation and reduction of Tl^+ ions by trapping holes and electrons and subsequent reactions of the (assumed) Tl^0 and Tl(II) species. (auth)

9447 THE INFLUENCE OF GAMMA-RADIATION ON THE CATALYTIC ACTIVITY OF THE COMPLEX FORMED BY COPPER WITH GLYCL-L-α-ALANINE. Salakhutdinov, U. I.; Borisova, A. P.; Savich, I. A.; Spitsyn, Vikt. I. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 183: 878-80(Dec. 1, 1968). (In Russian).

Gamma-radiation effects on the catalytic activity of copper hydrocomplex with glycyl-L-α-alanine were studied using a model reaction of N-nitro-phenylacetate hydrolysis. Absorption spectra for irradiated and nonirradiated complexes of copper with glycyl-L-α-alanine are tabulated and analyzed. (R.V.J.)

9448 REACTIONS OF ENERGETIC ^{11}C-ATOMS IN FLUOROHYDROCARBON SYSTEMS. Ache, Hans J.; Wolf, Alfred P. (Brookhaven National Lab., Upton, N. Y.). Radiochim. Acta, 10: 41-3(1968).

In the reactions of energetic ^{11}C atoms with partially fluorinated ethanes the total yield of organic "hot" reaction products formed can be related to the number of C–H bonds available in the substrate molecules. The yields of the individual "hot" products, such as acetylene and ethylene, both show a structure dependence and the expected bond energy effects. (auth)

9449 CHEMICAL EFFECTS OF (n,γ) REACTION IN HEXACHLOROIRIDATE(IV) CRYSTALS. Cabral, J. M. Peixoto (Junta de Energia Nuclear, Sacavem, Portugal). Rev. Port. Quim. (Lisboa), 9: 210-50(1967). (In Portuguese).

The results of experimental investigations on chemical effects associated with the (n,γ) reaction in $Na_4IrCl_6 \cdot 6H_2O$, $Na_2IrCl_6 \cdot 2H_2O$, NH_4IrCl_6, and K_2IrCl_6 are reviewed. Data for γ irradiation of fresh $Na_2IrCl_6 \cdot 2H_2O$ solutions in 0.01 N HCl indicate that the $IrCl_6^{--}$ is oxidized to $IrCl_6^-$. Results of electrophoretic studies carried out with solutions of nonirradiated $Na_2IrCl_6 \cdot 2H_2O$ in 0.01 N HCl heated to 100°C in a closed vessel for 6 days indicated the presence of two cationic species, probably $Ir(H_2O)_4Cl_2^+$ and $Ir(H_2O)_5Cl^{2+}$. (auth)

9450 GAMMA-INDUCED ABSORPTION IN SILICATE GLASSES CONTAINING TITANIUM. Bishay, A. (American Univ., Cairo); Gomaa, I. Phys. Chem. Glasses, 9: 193-9(Dec. 1968).

The γ-induced optical absorption of a series of barium silicate glasses containing different concentrations of TiO_2 was studied. A decrease in the intensity of the induced absorption was observed as TiO_2 was increased. Gaussian resolution of the induced optical absorption and electron spin resonance studies indicated the formation of Ti^{3+} ions in the glass as a result of γ irradiation. The effects of increasing TiO_2 on the number of color centers induced in the different glasses showed pronounced changes at compositions containing between 2 and 5 mole % TiO_2 and at about

10 and 16 mole %. Similar changes were observed in the molar volume of this series of glasses. The glass samples were devitrified by heat treatment. X-ray diffraction studies of the devitrified samples showed the appearance or disappearance of certain compounds at the above compositions. (auth) (UK)

9451 PROCESS FOR THE PREPARATION OF ANHYDROUS HYDRAZINE. Gaussens, Gilbert (to Commissariat a l'Energie Atomique). British Patent 1,137,210. Dec. 18, 1968. Priority date Nov. 19, 1965, France.

Anhydrous hydrazine was prepared by the radiolysis of NH_3 in the presence of acetone. The irradiation was carried out with x rays, γ rays, or pulsed electrons with an intensity between 25 and 50 MRAD/hr to a dose of 100,000 to 600,000 RAD. The acetone was present in concentrations of 0.3 to 1 m/l of ammonia. After radiolysis, the hydrazine was separated by distillation under subatmospheric pressure. (B.L.M.)

9452 RADIATION GRAFT-POLYMERIZATION METHOD. Kawamura, Katsuyuki (to Sumitomo Electric Industries, Ltd.). Japanese Patent 1968-18703. Aug. 14, 1968. Filed May 27, 1965.

Ion-exchange membranes with superior flexibility and rubber-attached cloth with high oil and radiation resistance were prepared by radioinduced graft polymerization of a monomer of the vinyl system onto the rubber base. The base is brought into contact with the monomer into which a fatty acid has been dissolved during the irradiation. (NSA of Japan)

9453 POLYMERIZATION OF ACRYLONITRILE IN A METHYLTETRAHYDROFURAN GLASS AT LOW TEMPERATURE. Bodard-Gauthier, Monique; Marx, Rose (Faculte des Sciences de Paris, Orsay, France). J. Polym. Sci., Part C, No. 16, 4241-53(1968). (In French).

From IUPAC Meeting on Macromolecular Chemistry, Prague. See CONF-650801-(Pt.7)).

The polymerization of acrylonitrile in methyltetrahydrofuran glass irradiated with γ rays at -196°C was studied. Such a medium was chosen because it can trap ions and electrons, therefore it is able to favor an ionic polymerization. Polymer yield versus monomer concentration presents a maximum at about 15% monomer. The influence of some additives on polymer yield and the composition of copolymers obtained in the presence of methylmethacrylate show that here acrylonitrile polymerization proceeds through an anionic mechanism. The radicals formed under irradiation and the ions responsible for polymerization were observed by ESR and absorption spectroscopy. (auth)

9454 OXIDIZING RADIOLYSIS OF POLYOXYETHYLENEGLYCOL IN DILUTE CHLOROFORM SOLUTION. Gugumus, Francois; Marchal, Jean (CRM, Strasbourg). J. Polym. Sci., Part C, No. 16, 3963-72(1968). (In French).

From IUPAC Meeting on Macromolecular Chemistry, Prague. See CONF-650801-(Pt.7)).

The radiation chemistry of polyethylene oxide in aerated chloroform solutions was studied by exposure to $^{60}Co-\gamma$ rays. The rate of chain scissions was determined by viscosity measurements. The rates of formation of formates and formals resulting from degradation were measured by ir spectroscopy and colorimetry. A kinetical scheme based on monomolecular decomposition of peroxy macroradicals PO_2 leading to a formate and an α-alcoxyalcoxyl radical is proposed to explain the results. As this radical can attack other polymer molecules or its own chain, the degradation is explained by means of the superposition of a random scission process and of a nonrandom one leading to products of low molecular weight. (auth)

9455 OXIDIZING RADIOLYSIS OF POLYSTYRENE IN DILUTE CHLOROFORM SOLUTION. Abadie, Marc; Marchal, Jean (Centre de Recherches sur les Macromolecules, Strasbourg). J. Polym. Sci., Part C, No. 16, 4011-18(1968). (In French).

From IUPAC Meeting on Macromolecular Chemistry, Prague. See CONF-650801-(Pt.7)).

The radiolysis effects on molecular parameters of polystyrene irradiated in chloroform solution were studied. Samples of molecular weight between 3000 and 1,500,000, which were obtained by radical or anionic polymerization were used. Experiments show that chain scission rapidly reaches a limit that is a function of intensity and independent of initial molecular weight. (auth)

9456 RADIATION-INDUCED POLYMERIZATION OF GASEOUS ETHYLENE. I. ROLE OF SOME IMPURITIES ON POLYMERIZATION. Munari, S.; Russo, S.; Castello, G.; Rossi, C. (Univ., Genoa). J. Polym. Sci., Part C, No. 16, 4149-59(1968).

From IUPAC Meeting on Macromolecular Chemistry, Prague. See CONF-650801-(Pt.7)).

Gamma-radioinduced polymerization of ethylene was carried out under pressure at room temperature with research-grade-purity monomer. No induction period was noticed in these conditions; high conversion rates were obtained with good evidence for autoacceleration reactions. Stationary-state kinetics were applied in the first step of the reaction, and rate constants were calculated. The product was a linear or long-branched polyethylene; no double bond was found by infrared analysis. Molecular weights increased with decreasing intensity and with increasing total absorbed dose. The influence of O on the polymerization of ethylene, in the range from 10 to 1000 ppM, was also studied. The induction period increased with the O concentration, but no linear relationship was found between induction time and O concentration. After the induction period the polymerization took place at lower rates than pure ethylene, supporting a retardation effect of peroxidic species formed. Also investigated was the influence of added acetylene, which is also a primary product of the ethylene radiolysis, in a wide range of acetylene-ethylene ratios. The behavior of the system depends on acetylene concentrations. At low concentrations, acetylene acts as a retarder and as a chain transfer agent, producing a decrease of yields and of molecular weights. A possible mechanism for the interaction of acetylene with chain radicals is proposed. (auth)

9457 GASSES EVOLVED BY ^{60}Co RADIATION DEGRADATION OF STRONGLY ACIDIC ION-EXCHANGE RESINS. Mohorcic, Gorazd; Kramer, Vili (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia). J. Polym. Sci., Part C, No. 16, 4185-95(1968).

From IUPAC Meeting on Macromolecular Chemistry, Prague. See CONF-650801-(Pt.7)).

The irradiation damage and stability of polystyrene-divinylbenzene and phenol-formaldehyde sulfonic acid ion exchange resins was investigated by determination of the radiolytic gases. A 440 curies ^{60}Co radiation source was used. Commercial resins, Dowex 50W X10 and Zero-Karb 215, were prepared under strict conditions in free acid and in salt forms, in an excess of deaerated water, swollen with a known amount of water, and in a very dry state. A series of 6 equal samples were exposed to absorbed doses of 50 to 200 MRAD at a dose rate 2.5×10^5 RAD/hr. The gas analysis shows a very good linear dose dependence of the evolved H_2 and CO. The linearity of CO_2 is good for Dowex 50W X10 but less pronounced for Zeo-Karb 215. Sulfur dioxide is at least partially produced by direct action and is consumed by secondary reactions during irradiation. Under chosen experimental conditions the evolved H_2 amounts for the absorbed dose 1 MRAD are from 0.3 to 670 μmoles H_2/eq. resin. The values for CO_2 and CO are: 1.4 to 170 μmoles CO_2/eq. and 0.4 to 5.3 μmoles CO/eq. The corresponding G values are: 0.001 to 1.7 for H, 0.007 to 0.43 for CO_2, and 0.002 to 0.027 for CO. The G values for SO_2, calculated from the lowest absorbed doses, are between 0.001 and 0.87. (auth)

9458 STUDY ON THE RADIOCHEMICAL COPOLYMERIZATION IN THE SOLID PHASE OF MALEIC ANHYDRIDE WITH CERTAIN DERIVATIVES OF ACRYLAMIDE. Zurakowska-Orszagh, Janina; Wojno, Teresa (Univ., Varsovie, Poland). J. Polym. Sci., Part C, No. 16, 4219-24(1968). (In French).

From IUPAC Meeting on Macromolecular Chemistry, Prague. See CONF-650801-(Pt.7)).

The copolymerization in the solid state initiated by γ rays was examined in the case of binary systems composed of maleic anhydride with a homologous series of acrylamide derivatives giving eutectic mixtures. Maleic anhydride was chosen because of its low homopolymerization tendency particularly in the solid state even at high irradiation doses. The other component was acrylamide, N-tert-butyl-acrylamide, N-tert-amyl-acrylamide, N-tert-hexylacrylamide, N-tert-heptylacrylamide, which polymerize in the solid state. The rate of cooling of the fused mixtures of the components exerts a marked influence on the degree of conversion after irradiation. The highest content of maleic anhydride in the copolymer was found for the system maleic anhydride-acrylamide. (auth)

9459 METHOD FOR CROSS-LINKING POLYMETHYL METHACRYLATE RESIN. Matsuyama, Kentaro (to Nippon Telegraph and Telephone Public Corp.). Japanese Patent 1968-13385. June 6, 1968. Filed Dec. 9, 1964.

Poly(methyl methacrylate) resin can be crosslinked between the molecular chains, to improve its physical, chemical, etc. properties by irradiation with ionizing radiation under an ethylene atmosphere of over 40 atm at 20 to 200°C. (NSA of Japan)

9460 SOME ASPECTS OF COTTON GRAFTING WITH ACRYLONITRILE UNDER THE ACTION OF γ RADIATIONS. Ciubotariu, M.; Feldman, D.; Simionescu, Cr. Celul. Hirtie, 17: 357-62(Sept. 1968). (In Rumanian).

The radiografting of some model sugars such as cellobiose, dextrine, and cotton cellulose with acrylonitrile was studied. The kinetic data show that the degree of grafting increases with

the irradiation dose. The chemical modifications are established by infrared spectroscopy, roentgenographically, and thermal analysis. The behavior of grafted cellulose toward the acid and alkaline solutions and the copper-ammoniacal solvent was also followed. (auth)

9461 VALENCE DISTRIBUTION OF ^{77}As RESULTING FROM β-DECAY IN ^{77}Ge-LABELLED INORGANIC CRYSTALS. Halpern, Aleksander; Sawlewicz, Krzysztof (Inst. of Nuclear Research, Warsaw). Nukleonika, 13: 921-9(1968).

The valence distribution of ^{77}As resulting from β-decay in ^{77}Ge-labelled germanium tetraiodide and germanium dioxide has been determined, the isothermal annealing in the latter being also studied. A protection effect of the arsenous carrier against oxidation was found. Lattice imperfections influence the stabilization forms of radioarsenic, and the system was found to be very "structurally sensitive." The annealing curves differ from the usual form by having a number of maxima and minima. (auth)

9462 STUDY OF IRRADIATED SILICA–ALUMINA. I. STUDY OF ATOMIC HYDROGEN BY EPR. Vedrine, Jacques; Dalmai, Gisele; Imelik, Boris (CNRS, Villeurbanne, France). J. Chim. Phys., 65: 1780-93(Oct. 1968). (In French).

Studies were made of hydrogen atoms formed by γ-irradiation of silica–alumina. Shapes and saturation of the EPR spectral lines are discussed in terms of dipolar broadening, spin-lattice relaxation, homogeneous broadening, rate of passage, and modulation parameters used for observation. The signal is a superposition of two lorentzian lines a and b due to trapped hydrogen atoms on two different sites. The values of spin-spin and spin-lattice relaxation times turn out to be 10^{-7} second for T_2 and 10^{-4} second for T_1. The influence of paramagnetic molecules of oxygen and peroxide radicals on T_1 was also studied. Hydrogen atoms are stabilized in 10 Å depth surface layer and close to V-centers of the material. Trapped atoms yield was found to be linear with water and alumina contents of the sample and to be independent to Brönsted acidity. A model of trapping sites is suggested from the deviation between the values of hyperfine coupling constant and electronic g-factor for trapped hydrogen atoms and the values of these constants for free hydrogen atoms. It is assumed that an hydrogen atom is weakly bonded by one electron bond to an oxygen atom of the lattice. (auth)

9463 EPR STUDY OF RADICALS FORMED BY RADIOLYSIS OF LINEAR ALKYL BROMIDES IN SOLID PHASE. Dodelet, Jean-Pol (Fonds National de la Recherche Scientifique, Brussels); Fauquenoit, Christian; Claes, Paul. J. Chim. Phys., 65: 1734-41(Oct. 1968). (In French).

Some linear alkyl bromides (from C_4 to C_8) were irradiated at low temperatures. The paramagnetic species produced were examined by EPR. Radicals are produced by rupture of the C–Br bond. Isomerization from primary to secondary radical generally occurs in the case of the 1-bromo alkanes. (auth)

9464 STUDIES OF CHEMICAL EFFECTS PRODUCED BY (n,γ) REACTION IN HEXACHLORIDE CRYSTALS. IV. Cabral, J. M. Peixoto (Junta de Energia Nucleare, Sacavem, Portugal). Rev. Port. Quim. (Lisbon), 9: 161-83(1967). (In Portuguese).

The results of studies on chemical effects associated with the (n,γ) reaction in $Na_2IrCl_6 \cdot 6\,H_2O$, $Na_2IrCl_6 \cdot 2\,H_2O$, NH_4IrCl_6, and K_2IrCl_6 crystals are reviewed. In addition to the data already reported in a series of articles listed in the references, some new results are included. Gamma irradiations of fresh $Na_2IrCl_6 \cdot 2\,H_2O$ solutions in 0.01 N HCl have shown that the $IrCl_6^{3-}$ is oxidized to $IrCl_6^{2-}$. Electrophoreses carried out with solutions of non-irradiated $Na_2IrCl_6 \cdot 2\,H_2O$ in 0.01 N HCl, heated at 100°C in a closed vessel, for 6 days, have indicated the presence of 2 cationic species, very likely Ir $(H_2O)_4Cl_2^+$ and Ir $(H_2O)_5Cl^{2+}$. (161 references). (auth)

9465 NUCLEAR ISOMERS PRODUCED BY ^{60}Co IRRADIATION. Law, Joseph J. (Louisiana State Univ., Baton Rouge). J. Chem. Educ., 46: 49-50(Jan. 1969).

The production of radioactivity by photonuclear excitation of the ground-state is the most direct method of producing a metastable state. The induced activity can be used as a measure of the source activity, the dose rate, or the amount of the irradiated element in the sample, when all other parameters are fixed. In addition to the production and characterization of the nuclear isomers this experiment serves to introduce the concept of photon activation analysis. It can also be extended to the study of radiation dosimetry. (auth)

9466 FLUORESCENCE OF γ-IRRADIATED DNA AND PURINES IN AQUEOUS SOLUTION. Goedbloed, J. P.; Van Hemmen, J. J. (National Defence Research Organization, Rijswijk, Netherlands). Int. J. Radiat. Biol., 14: 351-61(1968).

In γ-irradiated solutions of DNA a characteristic fluorescence was observed which is not present before irradiation. On the basis of the excitation and emission spectra, it is concluded that two fluorescing components are present. One (A) has an excitation maximum at 310 nm and an emission maximum at 400 nm, whereas the other (B) has excitation maxima at 280 nm and 360 nm and an emission maximum at 450 nm. Both components were also found in irradiated guanine solution, with approximately the same spectral characteristics as in DNA. Component (A) results from attack by OH radicals, whereas both OH and reducing radicals are involved in the formation of (B). (auth)

9467 RADIOCHEMICAL SYNTHESIS OF COPOLYMERS POLYISOBUTYLENE–POLYSTYRENE. EFFECTS OF GRAFTING CONDITIONS ON THE CHARACTERISTICS OF COPOLYMERS. Jozefowicz, Jacqueline; Danon, Jeanne (Faculte des Sciences, Orsay, France). J. Chim. Phys., 65: 1742-50(Oct. 1968). (In French).

Detailed characterization of two copolymers obtained by direct radiation grafting of two different molecular weight poly(isobutylenes) dissolved in styrene was performed. The results show that these copolymers differ essentially by their chemical polydispersity. A grafting model taking into account the microphase separation occurring in the reaction medium and resulting from poly(styrene) and poly(isobutylene) incompatibility is proposed. It was concluded that poly(isobutylene) radiolysis consists essentially of main chain scission. The copolymers chemical polydispersity is such that low molecular weight chains are chemically heterogeneous, whereas high molecular weight chains are chemically homogeneous. The copolymers considered are essentially two sequence copolymers. (auth)

9468 OSCILLO-POLAROGRAPHIC STUDIES OF THE EFFECTS OF γ-RADIATION ON ADENINE IN AQUEOUS SOLUTION. Pleticha-Lang[illegible], R. (Univ. of Newcastle upon Tyne, Eng.). Int. J. Radiat. Biol., 14: 331-9(1968).

Gamma-radioinduced reactions of dilute aqueous solutions of adenine were studied by means of oscillo-polarographic methods. In the presence of oxygen the formation of a colored product was observed, whereas under anaerobic conditions formamidopyrimidines were found to be the main reaction product. A mechanism for the radiolysis of adenine in aqueous solutions is proposed. (auth)

9469 THERMAL ANNEALING OF THE RADIOIODINE RECOILS IN PROTON IRRADIATED POTASSIUM IODATE. Dema, I.; Zaitseva, N. G. (Inst. of Atomic Physics, Bucharest. Joint Inst. for Nuclear Research, Dubna, USSR). Rev. Roum. Phys., 13: 531-8(1968).

The role of radioiodine recoil fragments in the thermal annealing of high-energy proton-irradiated potassium iodate was studied. The influence of the proton flux on the retention and thermal annealing processes was also investigated. An explanation of the presence of free-oxygen species in the irradiated potassium iodate is proposed. (J.G.B.)

9470 THE SYNTHESIS OF 1,1,2-TRICHLOROBUTADIENE-1,3. Yumoto, Takaari; Matsuda, Tatsuo (Government Industrial Research Inst., Nagoya, Japan). Nagoya Kogyo Gijutsu Shikensho Hokoku, 16: 389-92(Nov. 1968). (In Japanese).

In the peroxide-induced as well as the radiation-induced addition reactions of ethanol to tetrachloroethylene, a mixture of 1,1,2,2-tetrachlorobutan-3-ol (I) and 1,1,2-trichloro-1-buten-3-ol (II) was obtained in good yields. When the reaction temperature was higher, the yield of II was better than that of I. II was dehydrated with P_2O_5 or Al_2O_3 to yield 1,1,2-trichlorobutadiene-1,3 (III). III was also prepared in the reaction of I and P_2O_5; in addition, a small amount of 3,3,4,4-tetrachlorobutene-1 was produced. (NSA of Japan)

9471 SZILARD–CHALMERS REACTIONS IN INORGANIC RHENIUM COMPOUNDS. Aten, A. H. W. Jr.; Kapteyn, Johanna C. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Radiochim. Acta, 9: 224(Oct. 1968).

The retention of radioactive rhenium and osmium in (n,γ) reactions of $KReO_4$, NH_4ReO_4, Re_2O_7, K_2ReCl_6, $(NH_4)_2ReCl_6$, OsO_4, K_2OsCl_6, and $(NH_4)_2OsCl_6$ was studied. The compounds showing 100% retention of Re(VII) were $KReO_4$, NH_4ReO_4, and Re_2O_7. Annealing of $(NH_4)_2ReCl_6$ was found to be quite normal and similar to that of K_2ReCl_6. Osmium on activation gave normal results, i.e., partial reduction of OS(VIII) and no oxidation of OS(IV). (D.H.M.)

9472 CORRELATION BETWEEN PHOTOCHEMISTRY AND HIGH-ENERGY RADIATION CHEMISTRY. Hammond, George S.; Caldwell, Richard A.; King, John M.; Kristinsson, Haukur; Whitten, David G. (California Inst. of Tech., Pasadena). Photochem. Photobiol., 7: 695-703(June 1968).

The initial interactions between high-energy radiation and a sample of condensed matter are complex. However, soon after the initial phases the excitation energy appears in well-known forms: ions, free radicals, and molecular excited states. These excited species are the immediate precursors of the stable chemical products. The nature of the chemically significant excited species can be inferred by studying the chemical changes induced in solutes which have been well characterized in photochemical studies. (auth)

9473 METHOD FOR PRODUCING KETONES WITH A POLYFLUORO FOUR-MEMBER RING. Muramatsu, Hiroshige (to Chief of the Agency of Industrial Science and Tech.). Japanese Patent 1968-12319. May 22, 1968. Filed Sept. 21, 1967.

A method is proposed for producing 2-hydroperfluorocyclobutyl alkyl ketone economically. To obtain the product of the general formula $CHF-CF_2-CF_2-CF-\overset{O}{\overset{\|}{C}}-R$, a mixture of perfluorocyclobutene and an aldehyde of general formula RCHO (where R is the alkyl group of carbon numbers 1 to 4) are irradiated with gamma rays. (NSA of Japan)

9474 RADIOLYSIS AND PHOTOLYSIS IN THE ADSORBED STATE. Rojo, Enrique A.; Molinari, Marcelo A. (Comision Nacional de Energia Atomica, Buenos Aires). Photochem. Photobiol., 7: 705-9(June 1968).

Simultaneous irradiation of gases or liquids adsorbed on high-surface-area solids of insulator or semiconductor properties frequently produces a considerable increase in radiolysis yields and selective effects in the distribution of products in comparison with those obtained by irradiation of pure substances. This kind of reaction is also sometimes observed when the solid is irradiated before adding the reactant. The results show that part of the energy absorbed by the solid is transferred by some mechanism to the adsorbate and is able to cause its decomposition. Some of the most representative experiments in the field are analyzed, with special attention on the interpretation of results and proposed reaction mechanisms. (auth)

9475 RECENT RESULTS FROM PULSE RADIOLYSIS. Swallow, A. J. (Christie Hospital, Manchester, Eng. Holt Radium Inst., Manchester, Eng.). Photochem. Photobiol., 7: 683-94(June 1968).

The technique of pulse radiolysis which has come into widespread use only within the last few years, is the high-energy analogue of flash photolysis and is providing a new insight into the chemistry of excited states, ions, and free radicals. In the method most commonly used, a pulse of high-energy radiation (about 1 to 1,000 nsec) is applied to the system under investigation (usually a liquid). A steady beam of light passing through the system enables changes in absorbance to be observed over periods from about 1 to 10 nsec after the pulse. Alternatively, any emission resulting from the pulse can be seen. Much of the work has been with aqueous solutions. The hydrated electron has been shown to react only very slowly with water, but it reacts with many solutes with second-order rate constants of up to about 2×10^{10} M^{-1} sec^{-1}. The reactions of products formed can be observed. For example, when hydrated electrons react with carbon monoxide they appear to give rise to hydrated formyl radicals, which react with each other with $2k = 5 \times 10^8$ M^{-1} sec^{-1}. In the field of substances of biological interest, the formation and reactions of free radicals from riboflavin and nicotinamide adenine dinucleotide have been studied. The rates of numerous other reactions of free radicals, including peroxy radicals, have been measured in aqueous solution. When aliphatic hydrocarbons are irradiated, most of the electrons produced return to the positive ions, but when solutes such as anthracene or naphthalene are present at high enough concentration the electrons can be captured by the solute. Neutralization then occurs rapidly giving rise to excited solute molecules. With styrene as solute, anion formation can be seen and the recombination observed. Other reactions of styrene intermediates have also been observed quantitatively, in the pure state as well as in various solutes. In the irradiation of solutions of iodine in cyclohexane various free-radical reactions have been observed, the charge-transfer complex of iodine atoms with the solvent being an important intermediate. Similar complexes have been observed in the irradiation of pure alkyl iodides. (auth)

9476 SPECTROSCOPIC EVIDENCE FOR IONIC PROCESSES OF γ-IRRADIATED ALKYL IODIDES AT −196°. Mittal, Jai Pal; Hamill, William H. (Univ. of Notre Dame, Ind.). J. Amer. Chem. Soc., 89: 5749-53(Nov. 8, 1967). (COO-38-536).

The optical absorption bands produced by γ irradiation of alkyl iodides in alkane matrices at −196° can be assigned to three species: 370 and 440 mμ, A; 390 and 480 mμ, B; 540 and 760 mμ, C. All are suppressed by positive charge traps, only B by electron traps. Isothermal relaxation in a soft matrix shows that A → B, A → C, and C → B. Only A appears initially at small RI, but all appear at large RI. Assignments are A = RI^+, B = $RI \cdot I^-$, C = $(RI)_2^+$. The ^2P states of RI^+ account for the separations of the A bands. Efficient formation of $RI \cdot I^-$ is attributed to ion recombination between RI^+ and I^-. The optically excited complex, RI^+I^-, has doublet character attributable to mixing of the ^2P states of RI^+, accounting for the B bands. Moreover, the known toluene and mesitylene (Ar) charge-transfer complexes with I were shown to form predictably from combination of Ar^+ with I^-. The assignment of C bands is supported semiquantitatively by previously reported excited states of persistent collision complexes of RI^+ and RI from mass spectrometry. These processes account for the major radiolytic effects. The formation of an identifiable charge-transfer complex $A \cdot C$ by recombination of C^+ and A^- provides the possibility, in suitable instances, of resolving a major mechanistic problem in radiation chemistry. (auth)

9477 G-VALUE DETERMINATION OF THE FRICKE DOSEMETER FOR 50 kVp X-RAYS. Geisselsoder, Janet; Karzmark, C. J. (Stanford Univ., Palo Alto, Calif). Phys. Med. Biol., 14: 61-71(Jan. 1969).

The Fricke ferrous sulphate dosemeter was calibrated against a plane-parallel extrapolation chamber for 50-kVp x rays, HVL 0.20 mm Al, apparent quantum energy 12 keV. The energy absorbed in the dosemeter was assessed by the "relative effective density" method of Loevinger and Yaniv (Phys. Med. Biol. 10: 213(1965)). A tabulation of errors, systematic and random, inherent in these measurements, was made, and their effects evaluated. A value of $G_{Fe^{3+}} = 14.63 \pm 0.25$ was obtained. (auth) (UK)

9478 REACTIONS IN THE ^{60}Co IRRADIATION OF PYRIDINE AND METHYLPYRIDINES. Duvall, J. J.; Jensen, H. B. (Bureau of Mines, Laramie, Wyo.). J. Phys. Chem., 72: 4528-34(Dec. 1968).

Gamma irradiation of nitrogen bases found in shale oil was studied as a possible means of enhancing their value. Pyridine, 2-methylpyridine, 3-methylpyridine, 4-methylpyridine, and 2,6-dimethylpyridine were subjected to ^{60}Co irradiation with total dosages of 2×10^7 to 2×10^8 RADS. G values for hydrogen, methane, acetylene, methylacetylene, and polymer, as determined by gas–liquid partition chromatography and mass spectroscopy, are reported. Products resulting from rupture of bonds external to the ring, rupture of ring bonds, aromatic substitution, and intramolecular rearrangement are reported. Respective examples of each of the above reactions on irradiation of 2-methylpyridine are the formation of methane, acetylene, 2,4-dimethylpyridine, and 3-methylpyridine. Possible reaction mechanisms are discussed. Dealkylation of methylpyridines occurred but not in significant amounts. (auth)

9479 METHOD FOR PRODUCING ETHERS CONTAINING POLYFLUORO FOUR-MEMBER RINGS. Muramatsu, Hiroshige (to Chief of the Agency of Industrial Science and Tech.). Japanese Patent 1968-13211. June 4, 1968. Filed Mar. 26, 1965.

A method is proposed for the simple economical preparation of ethers with a 2-hydroperfluorocyclobutyl group, which are useful as organic solvent. The ethers are prepared by irradiation with ionizing radiation of a mixture of perfluorocyclobutene, and tetrahydrofuran, dioxane, or diethyl ether, to bring about the desired reaction. The desired reaction may also be achieved by using a peracid ester. (NSA of Japan)

9480 THE RADIATION-CHEMICAL TRANSFORMATION OF β-OXYETHANETHIOL. Nanobashvili, E. M.; Chirakadze, G. G.; Mosashvili, G. A. (Inst. of Inorganic Chemistry and Electronics, Tbilisi, USSR). Khim. Vys. Energ., 2: 403-7(Sept.–Oct. 1968). (In Russian).

The radiochemical transformations of pure β-oxyethanethiol and its solutions in isooctane and water were studied in an atmosphere of air or helium under the action of x and γ radiation. A significant decrease in radiation stability of the sulfhydryl group of the compound was observed in comparison to corresponding thiols. The radiation yield can reach 400 molecules/100 eV. The sulfhydryl group protects the hydroxyl group both in β-oxyethanethiol and in equimolar mixtures of ethanethiol and alcohol. Identified among the products of radiolysis were sulfate ions, hydrogen sulfide, peroxides, carbonyls, and carboxylic compounds. Possible mechanisms for the radioinduced transformation of β-oxyethanethiol are discussed. (tr-auth)

9481 INFLUENCE OF THE STRUCTURE OF CERTAIN ALKYL-SUBSTITUTED CYCLOHEXANES ON THEIR RADIOLYSIS. Makarov, V. I.; Chernyak, N. Ya. (Inst. of Petrochemical Synthesis, Moscow). Khim. Vys. Energ., 2: 408-12(Sept.–Oct. 1968). (In Russian).

Yields of H_2 and products containing 1 to 4 carbons from the radiolysis of cyclohexane and six alkyl derivatives were measured. The rupture of the alkylcyclohexane molecule occurs mainly at the point of attachment of the side groups and especially at the point with the greatest density of branchings. Products that emerge on rupture of the cyclohexane ring were also discovered. Yields in ring decomposition were calculated and it was found that alkyl side groups inhibit this process. (tr-auth)

9482 THE RADIATION CHLORINATION OF PARAFFINS. II. THE CHLORINATION OF SOFT PARAFFINS (C_{16}–C_{18}). Dzhagatspanyan, R. V.; Kosorotov, V. I. Khim. Vys. Energ., 2: 418-23(Sept.-Oct. 1968). (In Russian).

Kinetics and diffusion mechanisms in the radiation chlorination of soft paraffins were determined. The effects of temperature and radiation dose rate on the reaction kinetics were investigated. Where the rate of the diffusion process does not depend on dose rate, the rates of chlorination of soft paraffins and n-tetradecane under equal hydrodynamic conditions are equal. This permits a conclusion to be drawn concerning the larger specific contribution of diffusion resistance in the gas phase at the expense of the desorption of HCl. The activation energy of the process in the diffusion region is equal to zero. With increasing temperature the rate of chlorination as a function of dose becomes less pronounced. (tr-auth)

9483 THE INFLUENCE OF TEMPERATURE AND OXYGEN ON THE COMPOSITION OF PRODUCTS FROM THE GAMMA RADIOLYSIS OF n-HEPTANE. III. THE PRODUCTS OF OXIDATION CONTAINING SEVEN CARBON ATOMS. Pichuzhkin, V. I.; Saraeva, V. V.; Chervoneva, L. A.; Bakh, N. A. (Moscow State Univ.). Khim. Vys. Energ., 2: 424-8(Sept.-Oct. 1968). (In Russian).

Oxidation products (alcohols, carbonyl compounds, and hydrogen peroxides) formed in the γ radiolysis of n-heptane in the presence of oxygen were identified. The effects of temperature on the composition and yields of products in the heptane series were studied. At low temperatures the yields of ketones decreased, and the yields of alcohols and hydrogen peroxides increased with increasing temperature. A new scheme is proposed for the formation of oxidation products in the low-temperature regions. (tr-auth)

9484 THE INFLUENCE OF PHENYL-β-NAPHTHYLAMINE AND SULFUR ON THE RADIATION OXIDATION OF RUBBERS. Degteva, T. G.; Novgorodova, E. Z.; Kuz'minskii, A. S. (Scientific-Research Inst. of the Rubber Industry, Moscow). Khim. Vys. Energ., 2: 438-43(Sept.–Oct. 1968). (In Russian).

It was found that phenyl-β-naphthylamine is a more effective inhibitor of radiation oxidation of rubbers than free sulfur at a dose rate of 2.3 MRAD/hr at 60 to 80°C. The amine and sulfur are consumed in the oxidation process and the consumption rate is higher in combination than separate. This is explained by a reaction of the amine with the sulfur. The product of their reaction is a less effective inhibitor than the amine but a more effective one than free sulfur. Molecules of the amine on radiation oxidation of SKN-26 rubber and of SKN-26 plus 1.5 wt % sulfur decompose with the formation of quinone. In SKI rubber this decomposition was not observed. On radiation oxidation of SKI, sulfur reacts with initial active centers and in SKN-26 it is joined to the polymer chains through an intermediate atom of oxygen. (tr-auth)

9485 LOCALIZATION OF FREE RADICALS IN IRRADIATED ALANINE–GLYCINE PEPTIDES. Usatyi, A. F.; Panin, V. I.; Ponomareva-Stepnaya, M. A.; Molodov, L. A. Khim. Vys. Energ., 2: 444-8(Sept.-Oct. 1968). (In Russian).

Electron paramagnetic resonance was used to investigate the localization of free radicals in irradiated alanine–glycine peptides. The molecules of the substance are glycine chains, one of the links of which is the alanine radical. The probability of the localization of free valence on the alanine link in relation to the position of alanine radicals in the peptide chain was studied. On irradiation of dipeptides the EPR of a radical that formed near the carbon end was recorded. For peptides with greater degrees of polymerization free valence was localized basically on end links that contain NH_3^+ and COO^- groups. The changes in EPR spectra with increasing dose can be explained by the migration of the free valence from alamine to glycine links in peptide. (tr-auth)

9486 THE FORMATION OF FREE RADICALS ON LOW-TEMPERATURE RADIOLYSIS OF DNA. Golikov, V. P.; Trofimov, V. I.; Leitin, V. L.; Kalmanson, A. E. (Inst. of Virology, Moscow. Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 2: 449-53(Sept.-Oct. 1968). (In Russian).

Electron paramagnetic resonance was used to study the irradiation of DNA from different origins by 1.6-MeV electrons. The curves showing radical accumulations were nonlinear up to doses of 10 MRAD and linear for doses above 10 MRAD. The radiation yield G(r) for radicals was greater in the nonlinear part than in the linear part. In all highly purified DNA at doses above 10 MRAD an EPR spectrum was observed on which was superimposed a single line. At low doses in highly purified DNA from bacteriophage CD a single structureless line was observed. In DNA from bacteriophage CD, in which 10 to 50% albumin is present, the EPR spectrum is characteristic of the albumin. The EPR spectra of highly purified RNA and molecular mixtures of desoxynucleotides differ from the spectra of DNA. It was concluded that EPR spectra similar to that of thymine molecules is observed only in high-purity DNA preparations at sufficiently high radiation doses. (tr-auth)

9487 DISCOVERY OF NONBIMOLECULAR REACTIONS IN THE RADIOLYSIS OF SOLUTIONS IN DIFFERENT SOLVENTS ON THE BASIS OF A STUDY OF THE $I^{1/4}$ RULE FOR STATIONARY CONCENTRATION. Ershler, B. V. (Inst. of Theoretical and Experimental Physics, Moscow). Khim. Vys. Energ., 2: 454-60 (Sept.–Oct. 1968). (In Russian).

It is shown that the $I^{1/4}$ rule, deduced from the equations of an approximate model for radiolysis at stationary concentrations, is determined by N, the number of kinds of atoms that compose molecules of the solvent and reacting particle. This is related to the fact that the parameter, p, determining the $I^{1/4}$ rule is found from the ratio $p = N-1$. The stationary state, which was reached on radiolysis of the solvent, represents a special case where $p = 0$. The dependence of the $I^{1/4}$ rule on the nature of the solvent and the mechanism of radiolysis permits the presence of nonbimolecular reactions to be shown by the radiolysis of different solvents. Thus it is possible, without investigation of the nature of the reactions taking place during irradiation, to find out if excited molecules of the solvents participate in the process of radiolysis. (tr-auth)

9488 APPLICATION OF THE POTENTIOSTATISTICAL METHOD FOR INVESTIGATION OF INTERMEDIATE PRODUCTS IN THE RADIATION OXIDATION OF Fe^{2+} IN 0.4M H_2SO_4. Moralev, V. M.; Bugaenko, L. T. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Khim. Vys. Energ., 2: 461-4(Sept.-Oct. 1968). (In Russian).

An apparatus for recording comparatively short-lived (0.1 sec) products from radiolysis by the potentiostatistical method is described. Values obtained for $k_{Fe^{2+}} + H_2O_2$ and the product yields from decomposition of water coincided with literature values. Values were obtained for the time necessary to establish stationary convective diffusion for rates of rotation of the disk electrode from 0 to 100 revolutions/sec. (tr-auth)

9489 RADIOLYSIS OF NITRIC ACID IN DIFFERENT PHASE STATES. Dmitriev, L. A.; Kamenetskaya, S. A.; Pshezhetskii, S. Ya. (Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., 2: 465-71(Sept.-Oct. 1968). (In Russian).

The radioinduced decomposition of nitric acid in different phase states was investigated in the temperature range from −196 to +32°C using γ radiation. It is shown that the decomposition of gaseous HNO_3 at 13 to 40 mm Hg and 25°C is a first-order reaction with a G-value of 21.7. In the radiolysis of solid HNO_3, a weak relation between the rate of decomposition and temperature was observed. In the region of the melting point and the transition to the liquid state the G-value increased sharply from 5.5 to ~11 and did not depend on temperature in the range from −35 to +32°C. From the EPR spectrum for irradiated solid HNO_3, the radicals NO_3 and NO_2 were discovered. Their conversions on exposure to visible light and on heating were studied. (tr-auth)

9490 SPECTROSCOPIC INVESTIGATION OF THE ACTION OF IONIZING RADIATIONS ON POLYVINYL CHLORIDE AT LOW TEMPERATURES. Sukhov, F. F.; Slovokhotova, N. A. (Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., 2: 429-33 (Sept.-Oct. 1968). (In Russian).

Investigation of the changes in the infrared spectra of pure PVC (polyvinyl chloride) and PVC with additions of acetone and tetrahydrofuran on irradiation with fast electrons showed that the spallation of HCl from the polymer molecule with the formation of double bonds occurs at 100 to 120°C. The HCl, which is isolated on irradiation forms complexes with the polymer molecules, with molecules containing double bonds obtained by radioinduced dehydrochlorination, and with existing carbonyl and other groups in PVC. (tr-auth)

9491 CONJUGATED DOUBLE BONDS IN γ-IRRADIATED COPOLYMERS OF ETHYLENE WITH PROPYLENE AND α-BUTYLENE. Dzhibagashvili, G. G.; Slovokhotova, N. A.; Leshchenko, S. S.; Karpov, V. L. (Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., 2: 434-7(Sept.–Oct. 1968). (In Russian).

The action of ^{60}Co γ radiation on copolymers of ethylene with propylene or with α-butylene was studied. On the basis of ir and

electronic absorption spectra it was concluded that dienes and polyenes are formed on the radiolysis of these polymers. The lowest yield of conjugated double bonds was found in ethylene–α-butylene copolymers along with the lowest yield of free radicals. (tr-auth)

Radiochemistry

Refer also to abstracts 9359 and 9598.

9492 SELFINDUCED TRITIUM LABELING IN CYCLOHEXANE–BENZENE MIXTURES. Somma, Carmine T.; Ache, Hans J. (Virginia Polytechnic Inst., Blacksburg. Brookhaven National Lab., Upton, N. Y.). Radiochim. Acta, 10: 49-53(1968).

The self-induced T-labeling of the parent molecules in gaseous or liquid benzene–cyclohexane mixtures of various compositions occurs strictly proportional to the elapsed exposure time. The experimental conditions (500 mCi T_2) assure that more than 50% of the tritiated parent molecules are formed by a radiation-induced mechanism. The number of T atoms incorporated in cyclohexane or benzene under these conditions is a linear function of the electron fraction of cyclohexane or benzene in the reaction mixture. No indication of a possible charge transfer from radiolytically formed ionic cyclohexane species to benzene was observed. An attempt is made to explain the tritation of the cyclohexane in terms of radicalic mechanisms. (auth)

9493 SEPARATION OF RECOILING SPECIES FROM NEUTRON-IRRADIATED CHROMATE ION ON ION-EXCHANGER BY THE DYNAMIC IRRADIATION-ELUTION METHOD. Matsuura, Tatsuo (Rikkyo Univ., Yokosuka, Japan); Matsuura, Masataka. Radiochim. Acta, 10: 33-7(1968).

Continuous extraction of the ^{51}Cr-enriched cationic species during neutron irradiation of chromate and dichromate ions adsorbed on an anion exchange resin was carried out with nitric acid and other eluents. When acetylacetone or ethylenediaminetetraacetic acid were used as eluent, both yield and enrichment factor were high. The effects of the concentration of the eluent, irradiation temperature, and mesh size of resin upon the yield and the enrichment factor with acetylacetone as eluent were thoroughly studied, and the formation of a chromous species as an initial recoil product from chromate ion was suggested. (auth)

9494 EFFECTS OF PHASE HOMOGENEITY ON THE CHEMICAL CONSEQUENCES OF (n,γ) REACTIONS IN BINARY ORGANIC SYSTEMS CONTAINING BROMINE. Abedinzadeh, Z. (CEA de Saclay, Gif-sur-Yvette, France); Grillet, S.; Stevovic, J.; Tanaka, K.; Milman, M. Radiochim. Acta, 10: 38-41(1968).

The organic yield of ^{80m}Br produced in a number of solid, crystalline binary systems of organic halides (or hydrocarbon) and bromine, was found to be closely related to the phase diagrams of the mixtures. It was established that these diagrams present only well defined points (or regions) where the mixtures are truly homogeneous on the molecular scale and the chemical effects of nuclear reactions interpretable. (auth)

9495 SUBSTITUENT EFFECTS IN ^{130}I REACTIONS ACTIVATED BY (n,γ) AND (IT) WITH VARIOUS POLYHALOMETHANES. Parks, N. J.; Rack, E. P. (Univ. of Nebraska, Lincoln). Contract AT(11-1)-1617. Radiochim. Acta, 10: 26-9(1968). (COO-1617-5).

The organic yields of $^{130}I + {}^{130m}I$ activated by radiative neutron capture and those of ^{130}I activated by isomeric transition are found to decrease for the systems studied in the order $CH_2Cl_2 > CHCl_3 > CFCl_3 > CCl_4 \cong CCl_3Br$. The organic yields of (n,γ) activated $^{130m}I + {}^{130}I$ are consistently lower than the (IT) induced yields of ^{130}I. The products and their relative abundance were determined by radiogas chromatographic analysis. These determinations, together with other considerations, suggest the observed results may be primarily ascribed to variations in product stability which are related to variations in steric interactions among substituents of product molecules. (auth)

Separation Processes

Refer also to abstracts 9299, 9301–9303, 9312, 9328, 9359, 9367, 9442, 9493, 10180, 11039, 11153, 11154, 11251, and 11252.

9496 (ANL–7339) ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 11. OFF-GAS ANALYSIS. Ramaswami, D.; Anastasia, L. J.; Levitz, N. M.; Mecham, W. J.; Jonke, A. A. (Argonne National Lab., Ill.). July 1968. Contract W-31-109-Eng-38. 41p. Dep. CFSTI.

Fluid-bed fluoride-volatility processes are being developed for the recovery of fissionable values from spent nuclear-reactor fuels of low- and high-enrichment types. In these processes, the fissionable values are converted to volatile fluorides for separation and purification. The off-gas streams from the various process reaction vessels may contain one or more of the following gases: UF_6, PuF_6, BrF_5, HF, HCl, F_2, Br_2, H_2, O_2, and N_2. Many of these gases are reagents or products of chemical reactions, and analyses of the reactor off-gases for these constituents are necessary to provide information on the rates of reaction, the extent of reaction, and the utilization of reagents. Thermal-conductivity methods were developed and applied for continuous analysis of reactor off-gases and for possible application to automatic process control of the reactor. The application, operation, and performance of commercially available thermal-conductivity cells, as used in six benchscale and engineering-scale installations are described. Nickel cells with nickel wire filaments withstood the corrosive environments sufficiently so that stable operating characteristics and therefore a satisfactory operating lifetime can be anticipated for these cells in a fluoride-volatility process. (auth)

9497 (ANL–7468) ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 15. MATERIAL BALANCE DEMONSTRATIONS, PRODUCTION RATES, AND FLUORINE UTILIZATIONS IN FLUORINATION OF KILOGRAM QUANTITIES OF PuF_4 TO PuF_6 WITH ELEMENTAL FLUORINE IN A FLUID-BED REACTOR. Levitz, N. M.; Vogel, G. J.; Carls, E. L.; Grosvenor, D. E.; Murphy, W. F.; Kullen, B. J.; Raue, D. J. (Argonne National Lab., Ill.). July 1968. Contract W-31-109-Eng-38. 28p. Dep. CFSTI.

A total of 2.3 kg of PuF_4 was fluorinated with elemental fluorine in a fluidized bed of alumina to provide information pertinent to fluoride-volatility process flowsheets. Fluorination rates above 6 lb/(hr)(sq ft) of PuF_6 and material balances near 100% were achieved in early portions of the runs. Production rates of 2.4 and 4.1 lb/(hr)(sq ft) were obtained in three runs. Fluorine utilization efficiencies of 22, 17, and 28% were achieved. Plutonium deposited in equipment by radiation and thermal decomposition mechanisms, by elutriation from the fluidized bed, and as a result of reactions with minor chemical constituents or metal surfaces can be recovered by refluorination at 300°C. (M.C.G.)

9498 (ANL-Trans–692) DISMANTLING OF IRRADIATED FUEL ELEMENTS IN THE WAK. Huppert, K. L.; Zimmermann, G. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Atomwirt., Atomtech., 13: 426-8(Aug.-Sept. 1968). 9p. Dep. CFSTI.

An abstract of this paper, prepared from the original language appeared as NSA 22: 48910.

9499 (ANL-Trans–702) PYROCHEMICAL SEPARATION OF PLUTONIUM FROM IRRADIATED FUELS. Avogadro, A.; Wurm, J. G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Translated for Argonne National Lab., Ill., from report EUR/C-IS-1199/68. 18p. Dep. CFSTI.

A combined reprocessing system for recovery of plutonium from irradiated fuels is described. Extraction and pyrochemical concentration of plutonium is performed at the reactor site after a short cooling period. This is followed by a final plutonium refining in a special plant prior to refabrication of the fuel element. Complete destruction of the fuel is carried out in a bath of oxidizing and alkaline fused salts composed primarily of nitrates or peroxides. Chlorination is carried out on the uranate–plutonate precipitate. Uranium is then separated in the oxide form. The final purification of plutonium is achieved following the uranium separation. (M.C.G.)

9500 (ARH–407) SAFE ^{235}U ENRICHMENTS FOR THE PUREX FACILITY. Kiel, G. R.; Ridgway, K. R. (Atlantic Richfield Hanford Co., Richland, Wash.). Mar. 1, 1968. Contract AT(45-1)-2130. 9p. Dep. CFSTI.

The safe processing of uranium enrichments greater than 1.0 wt % ^{235}U in the Purex facility required a study to determine what enrichments could safely be processed. The control of criticality safety outside of geometrically favorable equipment in the Purex facility is considered. Where precipitation is not probable (requiring three or more independent operational errors), concentration control is used and advantage is taken of the nitrogen poisoning in uranyl nitrate solutions with or without plutonium. Where precipitation of uranium solutions is possible (requiring less than three independent operational errors), the maximum uranium density of the given precipitate is used to determine the enrichment limitation. For precipitated uranium–plutonium mixtures the Pu/U ratio of the precipitate is considered to be twice that of the original solution and the limiting equivalent enrichment is based on that ratio. Safe equipment mass limits are based upon a safe uniformly distributed slab of precipitate at a maximum uranium

density of 905 g U/l (if sulfate precipitation cannot be exluded, 970 g U/l must be used). The minimum critical enrichment of uranyl nitrate was determined by experiment to be 2.104 wt % with a standard deviation of 0.01 wt % resulting in a minimum of 2.07 wt % at the 99 percent confidence level. Since the calculational method used agreed very closely with this and other experiments, a calculated k_{99} of 0.98 was considered to give an adequate safety margin for specifying the maximum safe enrichments of precipitates. (auth)

9501 (ARH–732) RHODIUM SPECIES IN RADIOACTIVE WASTE SOLUTIONS. Hoffman, W. A. Jr. (Atlantic Richfield Hanford Co., Richland, Wash.). July 1968. 42p. Dep. CFSTI.

Evidence presented regarding the rhodium species leads to the conclusion that in an aqueous acidic nitrate matrix subject to high radiolysis, rhodium in low concentration forms the species $[Rh(NO_2)]^{3+}$. An adduct is formed, which absorbs in the ultraviolet at 268 mμ in the absence of comparable absorption by solutions of Rh(III), NO_3^-, NO_2, or N_2O, respectively. The adduct is formed by direct reaction with $NO_{(g)}$ or acidified NO_2^- solutions ($3HNO_2 = 2NO + NO_3^- + H_3O^+$). Mole ratio determination using either $NO_{(g)}$ or NO derived from NO_2^- yields a value Rh/NO of ½. Ion exchange studies indicate only one species of substantial stability. Charge determination indicates a value, 3+, for a mononuclear species. Products $Rh(NO_2)_3(OH)_3(H_2O)$ and $[Rh(NO_2)_2(py)_4](NO_2)(ClO_4)$ were isolated and identified by elemental analysis, infrared spectra, and mass spectrometry. A tentative identification of $[Rh(NO_2)_2]^{3+}$ was made in radioactive waste solutions. (auth)

9502 (BNWL–799) TBP AND DBBP SOLVENT EXTRACTION RECOVERY AND PURIFICATION OF $Bi(NO_3)_3$. Richardson, G. L.; Schulz, W. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1968. Contract AT(45-1)-1830. 19p. Dep. CFSTI.

Equilibrium data are presented for extraction of bismuth from nitric acid solutions into dibutyl butylphosphonate and tributyl phosphate solutions. These data were used to construct a study flowsheet for a solvent extraction process that should be capable of producing high-purity bismuth solutions. (auth)

9503 (BNWL–920) FEASIBILITY OF COMMERCIAL FUEL REPROCESSING IN THE REDOX PLANT. McKee, R. W.; Richardson, G. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1968. Contract AT(45-1)-1830. 87p. Dep. CFSTI.

The prospect for enhancing the feasibility of Redox conversion by more fully utilizing its high throughput capability was examined. Flowsheet development that would permit use of the present Hexone Process by reducing the large waste volumes associated with it is considered. Economics are discussed. (M.C.G.)

9504 (CEA-R-3582) SEPARATION OF ^{228}Ra (Ms Th 1) FROM THORIUM NITRATE. Arnoux, Micheline; Gizon, Andree; Herment, Jacques (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Oct. 1968. 15p. (In French). Dep.

Treatment of 135 kg of thorium nitrate (purified and recrystallized in 1958) was made for extraction of ^{228}Ra in equilibrium. Elimination of the preponderant part of thorium by solvent extraction (TBP) and last purification by chromatography (Dowex 50 W X 8 and 1 X 8). Total yield was about (38 ± 4)%. (auth)

9505 (DOCKET-50268–1) MIDWEST FUEL RECOVERY PLANT, [MORRIS, ILL.]. Design and Analysis. (General Electric Co., Santa Clara, Calif. Nuclear Energy Div.). Nov. 21, 1966. 348p. Dep. CFSTI.

A request for authorization of uranium, plutonium, and neptunium recovery from irradiated central power reactor fuels at the Midwest Fuel Recovery Plant is presented. The facility will use the Aquafluor process to treat 300 tons/yr of irradiated uranium in the form of compacted UO_2 clad in stainless steel or zirconium alloys. Information supporting the request is given under the following broad headings: introduction, design criteria, site and environs, facility description, process systems description, radiological protection and confinement systems, auxiliary systems, safety analyses, management systems, preoperational testing, and technical specifications. (M.C.G.)

9506 (EUR–4184) HALIDE SLAGGING OF RARE EARTH FISSION PRODUCTS IN MOLTEN URANIUM. Sennewald, G.; David, C.; Wurm, J. G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Aug. 14, 1968. 36p. Dep.

The extraction of cerium and lanthanum from molten irradiated uranium with a molten salt bath containing UCl_3 was studied. The use of $^{235}UCl_3$ as a chlorinating agent seems to be very attractive, also ^{235}U losses to the salt bath by isotopic exchange are negligible. A decontamination factor of 3×10^4 for Ce and La was reached under the following simulated conditions: 1 kg of irradiated U (10% burnup) with 100 gr of UCl_3 in the slagging salt at 1,250°C. Two other results are mentioned: A limited halide slagging of Ce and La can be performed with $CaCl_2$ and $BaCl_2$ alone without UCl_3. An attempt was made to explain this reaction mechanism. The solubility of cerium in molten cerium at 1.250°C was redetermined to 0.0194 mol %. This value is 100 times lower than reported previously in the literature. (auth)

9507 (EUR–4192) STUDY OF THE PROBLEMS POSED BY THE TREATMENT OF EFFLUENTS CONTAINING DETERGENTS AND COMPLEXING AGENTS. Verot, J.-L.; Blum, J.-M.; Hazera, J.; Sarfati, R. (Ugine-Kuhlmann S. A., Paris (France)). July 12, 1968. Contract 003-65-3 WASF. 65p. Dep.

Radioactive effluents, usually of low specific activity, raise certain problems for processing plants. These effluents come from hot laundries as well as from equipment decontamination workshops; they contain washing products consisting of sequestering and nonredepositing "BUILDER" detergents. An inquiry was therefore undertaken to draw up a catalog of the problems that decontamination and the waste processing were liable to raise. A solution was sought that would result in an improvement in the processing of effluents from decontamination plants. The problems studied with a view to facilitating the treatment of effluents in the evaporators included the photochemical destruction of sequestrants, the displacement of the EDTA complexes, and the use of new foam inhibitors. New washing formulas and decontaminating agents with which it is possible to decontaminate effluents by conventional methods or by zeolites are being studied. (auth)

9508 (IN–1194) EFFECT OF SILICON ON FABRICATION AND REPROCESSING OF ALUMINUM ALLOY REACTOR FUELS. Paige, Bernice E.; Gibson, George W.; Rohde, Kenneth L. (Idaho Nuclear Corp., Idaho Falls). Nov. 1968. Contract AT(10-1)-1230. 89p. Dep. CFSTI.

The effect of silicon on both the fabrication and reprocessing of aluminum–uranium fuel was studied. Rolled castings of alloys used in these studies contained 0, 22, and 31% uranium, a range of silicon contents from 0 to 11%, and the remainder aluminum. Alloys were typical of those found in fuel element plates according to radiographic and metallographic examination. The silicon present in the alloys in excess of one atom of silicon per atom of uranium was segregated as elemental silicon in the aluminum matrix according to both x-ray diffraction and electron beam microprobe analyses. Maximum softness, as indicated by minimum tensile strength, was obtained in alloys with silicon-to-uranium atom ratios near one, while there was a hardening of the alloy above a ratio of one. The alloys were dissolved at the boiling point using nitric acid and mercuric nitrate catalyst for reprocessing studies. The dissolution rates and the preferential dissolution of aluminum compared to uranium were related to the metallurgical composition of the alloy which, in turn, is related to the silicon content. Both emulsion stabilization during liquid-liquid extraction of uranium and the quantity and nature of the solids produced during dissolution were related to the metallurgical composition of the alloys and to the atom ratio of silicon to uranium in the alloys. Residues were examined by centrifugation techniques, light scattering, and x-ray spectrographic analysis. (auth)

9509 (K–1769) ORGDP FUEL REPROCESSING STUDIES. Summary Progress Report, January–June 1968. Pashley, J. H.; Schappel, R. B. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Jan. 13, 1969. Contract W-7405-eng-26. 109p. Dep. CFSTI.

Processes aimed at purifying and recovering uranium and plutonium from spent nuclear reactor fuels were studied. The program included two main phases: preparation of conceptual plant studies with concomitant definition of problem areas associated with the process and technology and plant design; and component development, including scale-up and testing of crucial process equipment and auxiliaries. Topics covered include: the conceptual plant for processing of spent, low-enrichment LWR fuel; scoping calculations for the volatility processing of spent Fast Breeder Reactor fuels in the areas of alumina usage economics, the increase in static bed with radioactive heat generation, the transfer of fission product heat from reactors, reagent requirements for plutonium fluorination, and nuclear safety; process and reactor studies in the semiworks plant; outlet gas filter studies; uranium purification in a sorption-desorption system employing sodium fluoride; and the testing of the ORGDP design peripheral compressor. (auth)

9510 (KR–130) ANALYSIS FOR THE KJELLER REPROCESSING FACILITIES; DISCUSSION OF PROBLEMS AND METHODS. Bonnevie-Svendsen, M.; (and others) (Institutt for Atomenergi, Kjeleer (Norway)). June 1968. 81p. Dep.

The first analytical manual for the Kjeller reprocessing facility was worked out in 1959. Since then, the original analytical methods have been revised and improved. The processing of active fuel introduced several unforeseen analytical problems, e.g., the adsorption of Zr-Nb on crud and interfaces, the difficulties of obtaining representative aliquots for analysis, the determination of individual fission products, the control of the Pu valency state and of Ru complexes in the feed solutions. Further problems, e.g., the determination of U traces in organic Pu streams and the analysis of Pu in amine solutions, were connected with the application of Silex and amine flow sheets. These problems, and the precautions and new methods introduced to solve them, are discussed. The experience with the original methods is briefly reviewed. Examples of flowsheets and analytical dilution schedules illustrate the experimental conditions. The analytical methods applied for the different process streams are summarized in six tables. Detailed procedures for some methods, developed or substantially modified at Kjeller, are given in the Appendix. (auth)

9511 (MLM-1520) CHEMISTRY AND PHYSICS PROGRESS REPORT, APRIL-JUNE 1968. (Mound Lab., Miamisburg, Ohio). Dec. 16, 1968. Contract AT-33-GEN-53. 69p. Dep. CFSTI.

Research progress is reported on: the alpha-beta branching ratio of ^{227}Ac, praseodymium compound preparation, actinide dibenzoylmethane complexes, residue absorption, ^{234}U recovery, ^{229}Th recovery, ^{206}Pb recovery, decay scheme of ^{210m}Bi, resonant states of doubly closed shell plus one neutron nuclei, fast neutron spectroscopy, pulse-height analysis of radioactive gases, thin-crystal counting of ^{238}Pu in process solutions, determination of coincidence corrections, half-life determination by decaying pairs, and a high-wattage flow calorimeter. (M.C.G.)

9512 (ORNL-TM-2053) DISSOLUTION AND HYDROLYSIS OF METHYL IODIDE IN MISTING SPRAY SOLUTIONS. Parker, G. W.; Creek, G. E.; Horton, N. R. (Oak Ridge National Lab., Tenn.). Jan. 1968. Contract W-7405-eng-26. 20p. Dep. CFSTI.

Experiments indicated that the efficiency of 0.1M $Na_2S_2O_3$ and water sprays for removing CH_3I from the atmosphere are practically identical at room temperature. At approximately 48°C, the 0.1M $Na_2S_2O_3$ efficiency was about the same as that for room temperature, while the water spray efficiency was reduced. Henry's law constants and deposition velocities were calculated. (auth)

9513 (ORNL-4343, pp 86-90) METHODS DEVELOPMENT AND EVALUATION. (Oak Ridge National Lab., Tenn.).

IODATES—determination in thorium iodate, thermogravimetric
MOLTEN SALT REACTOR EXPERIMENT—fuel analysis for uranium by rapid-scan polarography
—fuel analysis for uranium, high-temperature fluorination apparatus for use in controlled-potential coulometric
REACTOR FUELS—analysis for uranium, rapid-scan polarographic
—analysis for uranium, high-temperature fluorination apparatus for use in controlled-potential coulometric
SMOKES—separation of components in tobacco, performance of gel-permeation chromatography for
THORIUM—determination in thorium iodate, thermogravimetric
THORIUM IODATES—analysis for iodate, thorium, and water, thermogravimetric
URANIUM—determination in MSRE fuel, rapid-scan polarographic
—determination in MSRE fuel, high-temperature fluorination apparatus for use in controlled-potential coulometric
WATER—determination in thorium iodate, thermogravimetric
(P.C.H.)

9514 (TID-24867) FIRST VTE PILOT PLANT REPORT, JULY 1, 1967. Research and Development Progress Report No. 367. (Oak Ridge National Lab., Tenn. Office of Saline Water, Washington, D. C.). 61p. GPO $1.25.

A pilot plant consisting of five vertical-tube evaporator effects with auxiliary equipment was constructed and tested. The plant, which could evaporate a maximum of 20,000 gallons of water per day under optimum conditions, was tested in both the rising-film and falling-film modes of operation using fresh water and sodium chloride solutions over the range of process conditions of interest in seawater evaporators. Improved heat transfer coefficients were achieved using evaporator tubes having enhanced (fluted or grooved) surfaces, and operability of the train of effects was satisfactory. The plant was disassembled and sent to the Office of Saline Water East Coast Engineering and Development Test Station, Wrightsville Beach, North Carolina, for tests using seawater. The plant equipment, test results, and the proposed test program are described. A photograph of the pilot plant is shown. (auth)

9515 EXTRACTION OF URANYL TRICHLORACETATE WITH ETHERS. Vdovenko, V. M.; Gasanov, A. I.; Mashirov, L. G.; Suglobova, I. G.; Suglobov, D. N. Dokl. Akad. Nauk SSSR, 182: 585-8(Sept. 21, 1968). (In Russian).

Uranyl nitrate occupies a unique position, inasmuch as it may be extracted from its aqueous solutions by simple ethers. In ether solutions uranyl nitrate forms neutral complexes, in which the anion and the uranyl ion are held together by a coordination bond. In view of the similarities in the electron-donor properties of the CCl_3COO^- and NO_3^- ions, the extraction of uranyl trichloroacetate by ethers from aqueous solutions was investigated. The compound was prepared by the dissolution of UO_3 in 5.5M solution of trichloroacetic acid. The equilibrium phase composition during concentration changes of the salt was determined by studying the solubility isotherm in the $UO_2(CCl_3COO)_2$-water-ethyl ether system measuring also the water concentration ether phase as a function of the salt concentration. The partition coefficient of the uranyl trichloroacetate between the aqueous solution and the TBP was found to be higher than in the case of the nitrate. The solvation energy, and thus the stability of the complex in the organic phase was found to depend on the number of water molecules which form the aqueous shell of the salt in the ether. The difference in the degree of hydration between the nitrate and the trichloroacetate is even larger in butyl ethers. (TTT)

9516 SEPARATION OF NITROGEN ISOTOPES BY ION EXCHANGE. Gorshkov, V. I.; Chumakov, V. A.; Boeva, V. V. (Moscow State Univ.). Zh. Fiz. Khim., 42: 3077-80(Dec. 1968). (In Russian).

Coefficients of a single stage of nitrogen isotope separation during ion exchange between 0.25 to 2.68 N ammonia solutions and NH_4^+ form of KU -2 × 9 cation exchange resin were determined. Coefficients diminished from 1.023 to 1.017 with the increased concentration of the solution due to the increased ammonia sorption. Nitrogen isotope separation by counterflow ion-exchange method was achieved with the KU - 2 × 9 cation exchange resin. The yield from the column was tabulated. The enrichment coefficient in the column I (for ^{14}N) was 5.47; in column II (for ^{15}N) it was 7.5. The magnitude of the height equivalent to theoretical step function was 1 to 3 cm with the rate of the solution flow from 0.3 to 0.69 cm/min and ionites from 0.05 to 0.12 min/sec. (tr-auth)

9517 EXPERIMENTAL SIMULATION OF THE NATURAL SEPARATION OF BORON ISOTOPES. Shergina, Yu. P.; Kaminskaya, A. B. (All-Union Inst. of Methods and Techniques of Prospecting, Leningrad). Geochem. Int. (Engl. Transl.), 4: 991-6(1967).

Translated from Geokhimiya, No. 9, 1111-15(1967).

Boron isotopes were fractionated by passing a borax solution through a column of hydromica-montmorillonite clay. A 2.3% increase of the $^{11}B/^{10}B$ ratio in the effluent was found. (auth)

9518 EXTRACTION OF RARE METALS FROM MOLYBDENUM ORE. Airapetyan, G.; Melkonyan, V.; Gukasyan, Zh. Prom. Arm., Sov. Nar. Khoz. Arm. SSR, Tekh.-Ekon. Byull., No. 4, 15-17(1967). (In Russian).

The problem of the complex treatment of Mo concentrates was studied. Re can be extracted from roasting dusts but the extraction of Se, Te, and Bi is more difficult. The final extraction of Re is ~30 to 35% since only 35 to 40% of the Re in the concentrate goes into the dust. A new method of trapping Re sublimates involves the injection of water vapor into the gas stream, which lowers the temperature from 350 to 400°C to 90 to 92°C, when Re_2O_7 flows down into the collectors. A method of treating Mo concentrates without roasting, by the hydrometallurgical treatment of the concentrate with HNO_3 is proposed. This gives a 97 to 98% extraction of Re and also extracts Se, Te, and Bi. (Metals Abstr.)

9519 CARRIER-FREE SEPARATION OF GADOLINIUM FROM PROTON-BOMBARDED EUROPIUM. Tomura, Kenji; Miyaji, Nobuyoshi; Nakamoto, Atsushi (Rikkyo Univ., Yokosuka, Japan). Radiochim. Acta, 10: 82-5(1968).

A procedure without any ion-exchange chromatography was investigated for separation of carrier-free gadolinium from the proton-bombarded europium oxide target. Europium is precipitated as Eu(II) sulfate after liquid zinc amalgam reduction in the presence of Ce(III) hold-back carrier for gadolinium. After Ce(IV) nitrate is removed by extracting it into methyl isobutyl ketone (MIBK), gadolinium is coprecipitated with Fe(III) hydroxide and then the iron is removed by MIBK extraction from hydrochloric acid. Finally, gadolinium is electrodeposited on a stainless steel cathode disk. Alpha particles of 3.18 and 3.01 MeV probably due to ^{148}Gd and ^{149}Gd, respectively, were observed with a surface-barrier silicon detector. (auth)

9520 SEPARATION AND DETECTION OF ^{237}U FROM RADIOACTIVE FALLOUT BY SOLVENT EXTRACTION METHODS. Suzuki, Toshio; Sotobayashi, Takeshi; Koyama, Seitaro; Kanda, Yukio (Niigata Univ., Japan). Nippon Kagaku Zasshi, 89: 1084-6(Nov. 1968). (In Japanese).

A method for rapid separation of ^{237}U from radioactive fallout using high molecular weight amine and quaternary ammonium salt was studied. The sample was decomposed by fusion with sodium carbonate, the melt was dissolved in hydrochloric acid, and then evaporated. The residue was dissolved in 0.1 N hydrochloric acid, $^{99}Mo-^{99m}Tc$ and the other anionic nuclides were extracted with tri-n-octylamine dissolved in xylene. The aqueous phase was adjusted to 3 N hydrochloric acid, ^{237}U and ^{132}Te were quantitatively extracted with trioctylmethylammonium chloride dissolved in benzene. The uranium and tellurium in the organic phase were then stripped into 0.1 N hydrochloric acid. The aqueous phase was adjusted to 0.5 N sulfuric acid, and uranium was extracted with tri-n-octylamine dissolved in xylene. The uranium was then stripped into 0.25 N nitric acid. The solution was evaporated, the residue was transferred into the dish available for counting in the usual way. The present procedure was applied to highly radioactive fallout particles and rain water resulting from the 5th and 7th Chinese nuclear tests. No detectable amount of radionuclides other than ^{237}U can be found in a γ-ray spectrum of the counting sample obtained through this procedure. (auth)

9521 MOLTEN SALT METHOD OF SEPARATION OF AMERICIUM FROM PLUTONIUM. Mullins, Lawrence J.; Leary, Joseph A. (to United States Atomic Energy Commission). U. S. Patent 3,420,639. Jan. 7, 1969.

This patent relates to a method of separating and recovering americium from plutonium in which both elements are contained in a molten salt solution. The separation is effected by the bubbling of a mixture of oxygen and argon gas into the molten salt solution, precipitating the plutonium as plutonium dioxide, and leaving the americium in the solution. (AEC)

9522 KINETICS OF MOLYBDENUM EXTRACTION BY 8-HYDROXYQUINOLINE AND ITS DERIVATIVES. Rudenko, N. P.; Kuznetsov, V. I. Vestn. Mosk. Univ., Ser. II. Khim., No. 5, 91-3(Sept.-Oct. 1968). (In Russian).

The kinetics of molybdenum solvent extraction by chloroform solutions of 8-hydroxyquinoline, 2-methyl-8-hydroxyquinoline, 5,7-dibrome-8-hydroxyquinoline, and 8-mercaptoquinoline were studied. It took less than ten minutes for equilibrium distribution of molybdenum between chloroform and water phases to be attained. Molybdenum concentration was 10^{-3} to 10^{-6} M, that of reagents in organic phase being 10^{-2} to 10^{-3} M, and the acidity of water phase ranged from pH 7 to 2 M HCl. (auth)

9523 REPROCESSING OF SPENT URANIUM FUEL. (to Japan Atomic Energy Research Inst.). British Patent 1,135,838. Dec. 4, 1968. Priority date Mar. 18, 1965, Japan.

A dry chlorination method is described for reprocessing spent uranium nuclear fuel material made up of metallic U, uranium oxide, or UC_2. The fuel is chlorinated in a reaction zone at a temperature of 400 to 700°C with a chlorinating agent selected from the group consisting of hexachloroethane, tetrachloroethylene, hexachloro-1,3-butadiene, or phosgene. The vapor containing mixed chlorides of U and fission products is passed through a bed of $BaCl_2$, which retains the UCl_4 and chlorides of fission products. Passage of an inert gas through the bed desorbs the fission products; and Cl_2 or diluted Cl_2 passed through the bed oxidizes the UCl_4 to UCl_6, which is desorbed. (B.L.M.)

9524 PROCESS FOR EXTRACTING AND CONCENTRATING EUROPIUM. Rombau, Paul (to Produits Chimiques Pechiney-Saint-Gobain). British Patent 1,132,804. Nov. 6, 1968. Priority date Jan. 31, 1966, France.

Europium sulfate is separated from a mixture of rare earth sulfates by treating the mixture of sulfates with Sm(II) to reduce the Eu to the bivalent state. The separation is carried out in the presence of H_2SO_4 and an alkaline earth metal salt, which readily precipitates and carries the insoluble $EuSO_4$ with it. The final separation is carried out by fractional crystallization to yield $EuSO_4$ of a quality suitable for use in fabrication of luminescent devices and of neutron capture devices. (B.L.M.)

9525 ELECTROLYTIC DISSOLUTION OF ELECTRONEGATIVE METALS. Raviv, Szmuel; Rabinovitz, Elsa; Malkiely, Shimon. British Patent 1,129,750. Oct. 9, 1968. Filed Sept. 28, 1967.

A method is presented for the dissolution in HNO_3 of a variety of electro-negative metals and metal alloys normally either not dissolved at all or dissolved only very slowly by this acid. Examples of these metals are: stainless steel, Inconel, Al, Cr, Ni, U, Ti, Zr, and their alloys. If a metal of this kind is inserted in HNO_3, and simultaneously connected as a cathode in an electrolytic circuit, the metal is dissolved; an unexpected result, in that each of these expedients if adopted by itself brings about passivation, that is a state antagonistic to dissolution. A possible application of the method would be the selective dissolution of a U fuel element envelope made from a metal of the kind specified, under conditions which do not affect the U core. (UK)

9526 SEPARATION TECHNIQUE FOR NONCONDUCTING SOLIDS IN LIQUID SODIUM. Vilinskas, P.; Schiltz, R. J. (Argonne National Lab., Ill.). Nucl. Appl., 6: 176-?(Feb. 1969).

A technique for separating solids from liquid sodium consists of applying a magnetic field to a confined liquid metal and passing a direct current through the molten metal at right angles to the magnetic field. The force field so established in the molten metal causes the suspended solid particles to move in the direction opposite to the force field, effecting their separation. The pressure that a solid particle will experience on one face is going to be greater than the pressure on the opposite face. By equating this pressure difference to the force of friction that resists the movement of the suspended particle the terminal velocity of the particle can be calculated. (auth)

9527 THE SEPARATION OF COPPER ISOTOPES BY ELECTROMIGRATION IN A CATION-EXCHANGE MEMBRANE. Kakihana, Hidetake; Kanzaki, Tadao (Tokyo Inst. of Tech.). Nippon Kagaku Zasshi, 89: 230-5(Mar. 1968). (In Japanese).

The electric conductivities of cation exchange membranes of various mono- and bivalent cation forms were measured. The order of the mobilities of the cations in the membranes was $H^+ > K^+ > Na^+ > Li^+ \gg Cu^{2+} > Ca^{2+} > Ni^{2+} > Mg^{2+} > Ba^{2+} \gg UO_2^{2+}$. Based on this result, the electromigration of Cu isotopes through the membrane was investigated by two different procedures. A 2 cm Cu zone inserted between two Li zones was moved through the cation exchange membrane under 12 to 24 V/cm. After 5.5, 50, and 100 hr migrations, the Cu zones diffused broadly to the rear, and for each case a maximum isotopic ratio($^{65}Cu/^{63}Cu$) was observed: both in the front and in the rear parts of the zone ^{63}Cu was enriched and in the middle part ^{65}Cu was enriched. From the anode compartment filled with 0.5 mole/l $CuSO_4$ aqueous solution the copper ion was introduced to a cation exchange membrane in the H^+-form by passing an electric current until a 2-cm copper zone was formed. Replacing the anode solution with 0.1 mole/l $CaCl_2$ aqueous solution, the Cu zone was followed by a Ca zone. After 10 hr migration under 5 to 25 V/cm the Cu zone migrated without any appreciable diffusion. The enrichment of ^{65}Cu at the rear part of the Cu zone was observed as clearly as the enrichment of ^{63}Cu at the front. Starting from the natural isotopic ratio ($^{65}Cu/^{63}Cu$) 0.445, the isotopic ratio changed to 0.436 or 0.439 at the front and to 0.452 or 0.451 at the rear. From these results, the relative difference(ϵ) between average migration velocities of two isotopic ions was estimated as 0.00012 to 0.00017. (NSA of Japan)

9528 ANION EXCHANGE SEPARATION OF BERYLLIUM, MAGNESIUM, CALCIUM, AND STRONTIUM BY USING A SOLUTION OF WATER AND MISCIBLE ORGANIC SOLVENTS. Kurokawa, Kozuo (Tokyo Metropolitan Hakuo Senior High School). Nippon Kagaku Zasshi, 89: 1076-80(Nov. 1968). (In Japanese).

Beryllium, magnesium, calcium, and strontium were separated by a column of anion exchange resin, Amberlyst-A29, using a mixture of ANO_3, methyl ethyl ketone, water-miscible alcohol, and KNO_3 eluting solution. The mixtures, $CH_3COC_2H_5$-7 mole/liter HNO_3-1 mole/liter KNO_3-H_2O (volume ratio: 90:5:2:3), i-PrOH-MeOH-7 mole/liter HNO_3(70:25:5), MeOH-i-PrOH-7 mole/liter HNO_3-1 mole/liter KNO_3-H_2O(80:10:5:2:3) and 0.1 mole/liter HNO_3 were used for the elution of Be, Mg, Ca, and Sr, respectively. The method was found to be effective for the rapid separation of Be, Mg, Ca, and Sr up to a total of 0.12 mmoles of metal ions. Beryllium ion was found to be adsorbed as $Be(NO_3)_4^{2-}$ with an anion exchange resin, although the stability constants could not be determined. Values of stability constants obtained in this work are $\beta_1'(Mg) = 1.36$, $\beta_2'(Mg) = 1.85$, $\beta_1'(Ca) = 0.80$, and $\beta_2'(Ca) = 2.08$. (NSA of Japan)

9529 COMPOUNDS FORMED ON EXTRACTION OF U^{6+} FROM $H_2C_2O_4$ SOLUTIONS WITH TRIOCTYLAMINE. Kuzina, M. G.; Lipovskii, A. A. Zh. Neorg. Khim., 13: 3333-6(Dec. 1968). (In Russian).

The extraction of U^{6+} from oxalate solutions by TOA was studied. On increasing the concentration of oxalic acid in the aqueous phase, the decrease in the coefficients of uranium distribution is accompanied by accumulation of $(TOAH)_3UO_2Ox_2HOx$ in the organic phase. The electronic and infrared spectra of the complexes and the extracts were measured. Results showed that all the groups were coordinately attached to uranium atoms. (tr-auth)

9530 THE EXTRACTION OF TRIPLE COMPLEX COMPOUNDS OF RARE EARTH ELEMENTS WITH THENOYLTRIFLUOROACETONE AND 1,10-PHENANTHROLINE BY ORGANIC SOLVENTS. Kononenko, L. I.; Vitkun, R. A. (Inst. of General and Inorganic Chemistry, Kiev). Zh. Neorg. Khim., 13: 3328-32(Dec. 1968). (In Russian).

The extraction of rare earth complexes with thenoyltrifluoroacetone and 1,10-phenanthroline by benzene was studied. It was found that the triple complex is extracted more efficiently than the double complex. The degree of extraction of rare earth elements at a given pH depends on the atomic number of the element, therefore this method can be used for separation of rare earths by countercurrent extraction. (tr-auth)

9531 REACTION OF SCHEELITE AND POWELLITE WITH NITRIC ACID [IN THE EXTRACTION OF TUNGSTEN]. Parkhomovskii, V. L. Obogashch. Rud, 69: No. 3, 26-8(1967). (In Russian).

The kinetics of the dissolution processes involved in the treatment of scheelite and powellite in HNO_3 were studied in connection with the hydrometallurgical purification of W concentrates. Results of HNO_3 dissolution of synthetic crystalline wolframite and Ca molybdate (particle size 0.100 to 0.088 mm) compared with the calculated dissolution rates of scheelite and powellite showed that the highest degree of W and Mo extraction could be attained in concentrated HNO_3. Tests were made with an industrial plant flotation concentrate of scheelite for purification from Mo, P, and $CaCO_3$ using a two-stage countercurrent flow process. These showed that the process is technically and economically very satisfactory. (Metals Abstr.)

9532 NUCLEAR FUEL RECOVERY. Anderson, C. R. Power Eng., 73: 50-1(Jan. 1969).

With the exception of noble gases and tritium, effluents from nuclear fuel recovery plants may be eliminated by providing a closed waste system having no discharge to the environs of either liquids or solids. Design requirements for a closed waste system are discussed. The high-activity waste stream is first concentrated in acid form. The residual liquid is then calcined to solid form and encapsulated in corrosion-resistant metal containers. These containers are stored in an in-plant vault. (M.C.G.)

9533 STUDY OF THE EXTRACTION SCHEME FOR ALKALI-METALS AND ALKALINE EARTHS BY DIALKYL PHOSPHATES. Mogno, Yvon; Kikindai, Tivadar (Ecole Centrale des Arts et Manufactures, Paris. CEN, Fontenay-aux-Roses, France). Compt. Rend., Ser. C, 267: 1373-6(Nov. 18, 1968). (In French).

The extraction of alkali metals and alkaline earths was carried out using dibutyl phosphate and bis(2-ethylhexyl) phosphate in benzene, o-dichlorobenzene, dodecane, hexane, and toluene solutions. The effects of element concentration, pH of aqueous phase, concentration of organic phase in the solvent, and nature of the diluent were investigated. The liquid-liquid extraction of alkali metals and alkaline earths is not accomplished by a unique mechanism like that of the trivalent metals by which the structure of the chelate complex varies with the concentration of the solvent. The nature of the inert diluent does not influence the scheme of extraction, but the value of the coefficient of partition of the element depends upon it quantitatively. (J.G.B.)

9534 RAPID SEPARATION OF ^{227}Ac FROM ITS DAUGHTER PRODUCTS. Blair, A. J.; Ihle, H.; Michael, H. (Kernforschungsanlage, Juelich, Ger.). Radiochim. Acta, 10: 119-21(Dec. 1968).

An ion-exchange prodedure for the rapid separation of actinium-227 from its daughters was developed. The mixture is loaded on a column of Bio-Rad AG 50W-X4, 20 to 26 μ, and eluted with 2.5N nitric acid at 60°C. After the elution of lead and radium, pure actinium is recovered; the elution of the actinium requires only 5 minutes. Thorium is finally eluted with 2N sulphuric acid. (auth)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 9571, 9585, 9587, and 11374.

9535 (PNE-G-25) INVENTORY OF WELLS AND SPRINGS WITHIN A 10-MILE RADIUS OF PROJECT GASBUGGY, RIO ARRIBA COUNTY, NEW MEXICO. Mercer, J. W. (Geological Survey [Denver, Colo.]). Dec. 1968. 12p. Dep. CFSTI. NCR $1.35.

Inventoried wells range in depth from 54 to 229 feet and generally are completed in the alluvium, which occurs in the valleys of the intermittent streams draining the area. Field specific conductance values obtained from the well water range from 700 to 2,600 micromhos per cm at 25°C. Inventoried springs are of the contact type and discharge from sandstones in the San Jose Formation. Some springs are seeps with little or no visible flow; others have yields that range from less than 1 gpm to more than 8 gpm. Field specific conductance measurements on spring water range from 370 to 2,300 micromhos per cm at 25°C. (auth)

9536 (PNE-G-26) HYDROLOGIC TESTS IN HOLE GB-1, PROJECT GASBUGGY, RIO ARRIBA COUNTY, NEW MEXICO. Koopman, F. C.; Ballance, W. C. (Geological Survey [Denver, Colo.]). Dec. 1968. 34p. Dep. CFSTI. NCR $2.52.

Hole GB-1, the initial exploration hole at the proposed Gasbuggy Project site, is in Rio Arriba County, New Mexico. Hydrologic data collected from the Ojo Alamo Sandstone in the hole indicate a static water level of about 1,000 feet below land surface and transmissivities of 0.4 gpd (gallons per day) per foot in the depth interval 3,475 to 3,575 feet below the kelly bushing (12 feet above land surface) and 2.6 gpd per foot in the depth interval 3,575 to 3,654 feet below the kelly bushing. The heads of the upper and lower sections are about equal. The specific conductance of the water in the sandstone is about 9,000 micromhos. This indicates a dissolved-solids content of about 5,500 parts per million. In the Kirtland Shale, Fruitland Formation, Pictured Cliffs Sandstone, and upper part of the Lewis Shale, in descending order, the section was drilled with gas as the circulating medium after the hole was cased into the upper part of the Kirtland Shale. Except for some core sections recovered in the lower part of the Pictured Cliffs Sandstone and upper part of the Lewis Shale that were reported to be moist, the yield of water to the hole is inferred to be very small. Relative specific capacity is 0.003 gpm (gallons per minute) per foot in the upper part of the zone and 0.016 gpm per foot in the lower part of the zone. (auth)

9537 (PNE-G-27) HYDROLOGIC TESTS IN HOLE GB-2, PROJECT GASBUGGY, RIO ARRIBA COUNTY, NEW MEXICO. Koopman, F. C.; Ballance, W. C. (Geological Survey, Washington, D. C.). Dec. 1968. 12p. Dep. CFSTI.

Hole GB-2, completed in April 1967, 465 feet east of hole GB-1 (SW¼ sec. 36, T. 29 N., R. 4 W.), was drilled to a depth of 3,662 feet below the kelly bushing. The hole penetrated the Ojo Alamo Sandstone from a depth of 3,478 to about 3,654 feet, as well as about 8 feet of the underlying Kirtland Shale. From hydrologic tests of the Ojo Alamo Sandstone data included specific conductance of the fluid removed from the hole, 1,400 micromhos during the earlier part of swabbing and 9,000 micromhos during the later part; temperature of formation fluid, 112°F; calculated transmissivity, 2.85 gpd (gallons per day) per ft; and calculated relative specific capacity, 0.026 gpm (gallons per minute) per ft. (auth)

9538 (TID-24290) REPORT OF EXPLORATION PROGRESS, PAHUTE MESA, JULY 31, 1966–JANUARY 31, 1968. Technical Letter: Special Studies-I-23-16. Orkild, Paul P. (Geological Survey, [Washington, D. C.]). Jan. 31, 1968. 68p. Dep. CFSTI.

The geologic exploration , geophysical logging, and hydrologic testing of the progress made in each Pahute Mesa hole are reported. Rock types encountered at each level are tabulated and stratigraphic correlations given. (D.C.W.)

9539 (UCRL-71187) RATE OF EVOLUTION OF THE EARTH'S CRUST. Higgins, Gary H. (California Univ., Livermore. Lawrence Radiation Lab.). Oct. 22, 1968. Contract W-7405-eng-48. 23p. (CONF-68111-1). Dep. CFSTI.

From Geological Society of America Meeting, Mexico City, Mex.

A simple mathematical model of the earth was derived to study the rate of melting induced by radioactive decay in a "protomantle" which is initially of uniform oxide composition. The assumptions were: the protomantle was initially solid; the local temperature was at the local melting point; the radioactivities were initially uniformly distributed; the radioactivities were enriched in the molten protomantle relative to the solid protomantle; molten protomantle material was then removed from the protomantle (migrated to the surface) in times short compared to the age of the earth; the present heat flow is in equilibrium with and equal to the present radiogenic heat; radial symmetry is preserved at all times. Consequences of application of the model are discussed for variations of time, fractionation ratio, and amount (thickness) of melt accumulated. The more important consequences are: the present rate of evolution of lava is predicted approximately; if the silica-rich phase is identified with the crust, the fractionation must be about 400-fold; and the crust, as we now know it, was 80% formed within 2×10^8 years after the mantle solidified. (auth)

9540 (UWFL-92) ATOLL SOIL TYPES IN RELATION TO THE DISTRIBUTION OF FALLOUT RADIONUCLIDES. Held, E. E.; Gessel, S. P.; Walker, R. B. (Washington Univ., Seattle. Lab. of Radiation Biology). Aug. 1965. Contract AT(45-1)-1385. 37p. Dep. CFSTI.

The redistribution of radionuclides in atoll soils following fallout from a nuclear device is described. The soils are calcareous, containing no inorganic colloids, and their exchange capacity is directly related to organic content. Comparison of gamma-ray spectra of depth increments from young and old soils shows that ^{137}Cs and ^{125}Sb move most readily in old soil, while the principal gamma-emitting radionuclide moving in young soil is ^{125}Sb. ^{90}Sr moves in both old and new soils, and quantitative differences in vertical movement between soil types is obscured by the highly variable surface distribution of the radionuclides. Vertical gradients in the distribution occurs within the surface inch. Litter redeposits ^{137}Cs and ^{90}Sr at the soil surface and bird droppings have added ^{65}Zn and ^{60}Co. In young soils the highest levels of radioactivity are associated with soil algae found as a surface crust in undisturbed areas and in coral fragments in eroded areas. Horizontal movement is localized. Buried organic horizons contain more ^{137}Cs than adjacent soil layers, and roots are generally more radioactive than the surrounding soil except at the soil surface. Pumice particles in the soil adsorb radionuclides but pumice is found infrequently. Mechanical mixing by animals in old soils and by erosion in young soils is important in the redistribution of radionuclides near the soil surface. ^{137}Cs and ^{90}Sr are the principal radionuclides entering a cycle within the soil-plant system. (auth)

9541 APPLICATION OF THE POTASSIUM–ARGON METHOD TO THE DATING OF SHOCKED ROCKS. Hartung, Jack Burdair. Houston, Tex., Rice Univ., 1968. 93p.

Thesis.

Natural rocks shocked by nuclear explosions and by meteorite impact have been analyzed for potassium and radiogenic ^{40}Ar. Argon loss due to a shock event is greater from feldspars than from biotite or hornblende. The primary mechanism for argon loss is believed to be an increased rate of diffusion which occurs in response to increased temperatures associated with the shock event, rather than to destruction of the crystal lattice by the shock wave itself. Strongly shocked and rapidly cooled ejecta material lost as much as 40% of the radiogenic ^{40}Ar present. Significant radiogenic ^{40}Ar loss was detected only in rocks showing definite evidence of moderate shock metamorphism and hydrothermal alteration or recrystallization. Samples which have been strongly shock metamorphosed and hydrothermally altered or partially or poorly recrystallized may lose essentially all of their radiogenic ^{40}Ar in the process, but they may also lose their capacity for complete ^{40}Ar retention following the shock event. Only thoroughly recrystallized samples are considered reliable for obtaining an accurate age for a shock event. K-Ar analysis of Brent, Ontario, Canada, crater samples produced evidence indicating samples containing new crystals produced from a melt may be distinguished from samples containing new crystals produced by devitrification on the basis of their K-Ar ages. Potassium-rich metasomatism or hydrothermal alteration occurred in connection with the crater-forming event and anomalously high hornblende ages for essentially unshocked Brent samples indicate the presence of considerable excess radiogenic argon or of relict hornblende grains which survived the Greenville metamorphism. The minimum age for the Brent impact event is 426 ± 20 million years. (Disser. Abstr.)

9542 FIELD MEASUREMENTS OF RADON IN THE AIR OF A COAL MINE IN SOUTHWESTERN ALBERTA. Wetherill, J. M. (Alberta Dept. of Health, Edmonton). Can. Mining Met. Bull., 61: 1335-6(Nov. 1968).

The results of an investigation into the level of radon at the Vicary Creek coal mine in Alberta as against the natural background are given. (F.S.A.)

9543 PROSPECTING WITH NEUTRONS. Wylie, A. W.; Eisler, P. L. (Commonwealth Scientific and Industrial Research Organization, Melbourne). At. Energy Austr., 11: No. 4, 6-12 (Oct, 1968).

The potential usefulness of instruments for sensing the occurrence of minerals near the walls of a drill hole, in particular a hole drilled with a percussion tool is discussed. The sensing instrument must withstand pressure, mechanical shock, and high temperatures. Gamma spectrometers, neutron induced gamma excitation, neutron reactions, detector shielding, neutron sources and the analysis of borehole data were investigated. (F.S.)

9544 THE FEASIBILITY OF RAPID SOIL INVESTIGATIONS USING HIGH-SPEED, EARTH-PENETRATING PROJECTILES. Caudle, W. N. (Sandia Lab., Albuquerque, N. Mex.); Pope, A. Y.; McNeill, R. L.; Margason, B. E. pp 945-55 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

A new method for remote and rapid soil investigations is described. Since 1962, about 700 full-scale earth penetrations have been accomplished using long, slender, instrumented projectiles dropped from aircraft. The projectiles contain accelerometers and other instruments, and they broadcast their decelerations during earth penetration through a long trailing antenna. The decelerations experienced by the projectile are used to estimate material properties. The entire determination is done from the air, and the resulting profile data identify weak and strong soils, granular and cohesive soils, and layer interfaces including bedrock. The profile data are similar to those from a Standard Penetration Test, and can be used with about the same confidence. A penetrator system is described for rapidly determining profiles in remote or inaccessible areas on land or under water. (auth)

9545 PROTACTINIUM METHOD FOR DETERMINING THE AGE OF YOUNG VOLCANIC ROCKS. Kuptsov, V. M.; Cherdyntsev, V. V. At. Energ. (USSR), 25: 241-2(Sept. 1968). (In Russian).

Gas streams containing the daughter elements enrich the radioactive element content of igneous rocks. The actual radioisotope concentration of a given rock depends on the specific exhalation process involved and therefore, the ionium, thorium, uranium, and protactinium ratios differ at various locations. Some recent Italian rocks are more enriched in protactinium than in uranium, while young Caucasian igneous rocks exhibit a $^{231}Pa/U$ ratio lower than the equilibrium value; this latter ratio depends on the age of the rock. Assuming that at the start the protactinium and ionium concentrations were equal to 0, it is possible to calculate the theoretically highest age of the rocks from known formulas. The protactinium content may be determined by its decay product AcA(^{215}Po), accumulated from Rd Ac(^{227}Ac) in a thorium preparation, using an ionization α spectrometer. Applicability of the method is limited by the very low specific activity of the rocks. The ages of the rocks examined were calculated on the basis of the $^{230}Th/^{234}U$ and $Pa/^{235}U$ ratios. The ages were found to be less than 14,000 years for the Elbrus rocks and less than 9,200 years for the Caucasian ones. It is concluded that the laccolites of the Caucasian mineral waters were formed during the Upper Pliocene-Pleistocene period. (TTT)

9546 NEW METHOD FOR THE COMBUSTION OF SAMPLES FOR RADIOCARBON DATING. Barker, H.; Burleigh, R.; Meeks, N. (British Museum, London). Nature (London), 221: 49-50 (Jan. 4, 1969).

Difficulties associated with the classical technique of combustion analysis in the preparation of samples for radiocarbon dating are pointed out. An alternative approach is the combustion bomb technique. In this method the principal problem is concerned with the quantitative separation of the small amounts of CO_2 from the large excess of combusting O_2. The procedure adopted at the British Museum Research Laboratory is described. The entire operation takes about 1 hour and, apart from the initial setting up and final transfer of CO_2 to the gas storage system, requires no operator attention. The success of the technique depends mainly on efficient CO_2 trap design and the use of a high capacity vacuum pump to maintain the appropriate low pressure within the trap system and also achieve a high rate of gas removal from the bomb. Precautions against sudden pressure rises are mentioned. (UK)

9547 CONTAMINATION OF FRESH WATER WITH RADIOACTIVE MATERIAL WITH SPECIAL ATTENTION TO SLUDGE OF RIVER DAMS. Ruf, M. Wasserwirtschaft, 58: 16-22(Jan. 1968). (In German).

The artificial radioactivity of freshwater in Bavaria differed in the years between 1957 and 1966 within a range of less than one $\mu\mu Ci/l$ up to 140 $\mu\mu Ci/l$. The water activity showed a direct dependence on the activity of rain, and the effects of nuclear power plants. Radioactivity in surface waters was caused by typical fallout products such as: ^{90}Sr, ^{89}Sr, ^{137}Cs, ^{103}Ru, ^{106}Ru, ^{141}Ce, ^{144}Ce, ^{95}Zr, ^{95}Nb, ^{54}Mn, ^{125}Sb. Since the 237-MW-KRB-reactor Gundremmingen reached its full capacity in November 1966, more waste has been passed into the river Danube. So radioactive corrosion products (Co-, Fe-, Mn- and Cr-isotopes) of low concentrations could be analyzed besides fission products (especially I-131). Radioactive substances were, to a large extent, concentrated in the sludge of river dams, in consequence of the increased sedimentation of seston particles. In this case the ^{137}Cs and ^{144}Ce-activity reached a 12- to 15,000 fold concentration of the water activity. In different fish of the river Isar and Danube a ^{137}Cs-activity 3,000 times higher than water activity was found. (auth)

9548 VERTICAL DISTRIBUTION OF ^{137}Cs, ^{125}Sb, AND ^{60}Co IN COASTAL MARINE SEDIMENTS. Cerrai, E.; Triulzi, C. (Centro Informazioni Studi Esperienze, Milan). Energ. Nucl. (Milan), 16: 36-40(Jan. 1969).

The vertical distribution of ^{137}Cs, ^{125}Sb, and ^{60}Co contents in coastal sediment samples of the Ligurian Sea was determined. Ten subsequent 2-cm thick fractions were analyzed beginning from the top of the cores. Such fractions derive from the blending of the corresponding fractions of seven cores collected on February 4, 1966 at 50 m depth. Information on radiochemical procedures applied is given. For comparison some already published values are also reported concerning the $^{90}Sr-^{90}Y$, $^{144}Ce-^{144}Pr$, ^{147}Pm, and ^{155}Eu contents. (auth)

Meteorology

Refer also to abstracts 9331, 9606, 9629, 9724, and 11384.

9549 (BNWL-715-3) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1967 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME II. PHYSICAL SCIENCES. PART 3. ATMOSPHERIC SCIENCES. Simpson, C. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1968. Contract AT(45-1)-1830. 203p. Dep. CFSTI.

Research progress is reported in twenty-four papers. A separate abstract was prepared for each paper. (L.C.L.)

For abstracts of individual papers see: 9550-9570, 9606, 9607, and 11374.

9550 (BNWL-715-3, pp 1-12) REAL TIME SAMPLING OF ZINC SULFIDE TRACER IN DIFFUSION STUDIES. Dotson, W. L.; Nickola, P. W.; Wolf, M. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A series of experiments were performed to measure the atmospheric diffusion of zinc sulfide tracer plumes using both ground-level and aircraft-mounted real time samplers. The results are compared and methods for interpreting the data are explained. (L.C.L.)

9551 (BNWL-715-3, pp 12-18) THE USE OF INSTANTANEOUS PLUME MEASUREMENTS TO APPROXIMATE A MEAN PLUME. Ramsdell, J. V. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A study is described that was undertaken to determine, from experimental data, the interrelationship between the instantaneous and mean properties of diffusing plumes. This has practical application since it is sometimes possible to measure only the instantaneous properties of a diffusing plume. A number of diffusion experiments were conducted at Hanford and in an Air Force study in which both instantaneous and mean measurement of the same plume were measured. An analysis of 12 of these tests demonstrates a rudimentary capability to transform instantaneous plume measurements to mean plume properties. (L.C.L.)

9552 (BNWL-715-3, pp 19-53) DIFFUSION OVER COASTAL MOUNTAINS OF SOUTHERN CALIFORNIA. Hinds, W. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Results from a large-scale program of diffusion studies, named Operation Mountain Iron, conducted by the Air Force, and carried out over the coastal mountains of Southern California are presented. Measurements were made for continuous ground level releases of about 15 to 30 sec duration. The site and experimental techniques are described. The data, their availability, and the development of techniques for estimating plume width are discussed. The results are compared with those from flatter terrain in the same climate. (L.C.L.)

9553 (BNWL-715-3, pp 54-7) ELECTRONIC DESIGN AND CONSTRUCTION OF A NOBLE GAS ATMOSPHERIC TRACER SYSTEM. Lashock, J. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An electronic system combining much available commercial equipment along with transistor and integrated circuit components specially designed to continuously collect and store data from at least 63 field-located radiation detectors has been developed and built. Atmospheric beta activity introduced by means of a radioactive noble gas tracer, ^{85}Kr, is monitored by 63 Geiger counters. The resultant signals enter preamplifiers specially designed to facilitate, through a long cable of up to 1600 meters, transmission to a central data sorting and accumulation and readout center. (auth)

9554 (BNWL–715–3, pp 58–62) AUTOMATIC REAL-TIME AIR MONITORING OF ^{85}Kr UTILIZING THE 4096 MEMORY OF A MULTIPARAMETER ANALYZER. Ludwick, J. D.; Lashock, J. J.; Connally, R. E.; Nickola, P. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A noble gas atmospheric monitoring field grid system in which ^{85}Kr is used as a tracer has been designed, assembled and used for studying atmospheric transport and diffusion. This system has demonstrated its usefulness in the quantitative measurement of the transport and diffusion of both continuous and true puff-type radioactive gas releases on a real-time basis. Small fluctuations in the air concentrations of the tracer are determined by using electronic instrumental data collection times as short as one second. The system consists of a large group of field detectors which relay their information to a 4096 address memory. The memory is programmed to accept information from 64 detectors. Information is accumulated in groups of 64 time channels and these groups are automatically stepped by the programmer. A time interval selector can be set to automatically regulate the stepping process at a slow or fast rate in effecting the desired differential data accumulation. The memory is read out on magnetic tape and the equipment is ready for the next field test 35 sec after completion of the first. (auth)

9555 (BNWL–715–3, pp 63–4) POLAROGRAPHIC TECHNIQUES APPLIED TO PROSPECTIVE ATMOSPHERIC PARTICULATE TRACERS. Ludwick, J. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A polarographic method, anodic stripping, for determining the amount of a single tracer particle in a rain drop or snow crystal is described. Antimony, cadmium, and zinc are recommended as particle tracers for these measurements. (L.C.L.)

9556 (BNWL–715–3, pp 65–73) THE MEASUREMENT OF PARTICULATE PLUME DEPLETION IN THE ATMOSPHERE BY COMPARISON WITH AN INERT GASEOUS TRACER. Nickola, P. W.; Ludwick, J. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The depletion of a plume of fluorescent particles (FP 2210) was computed by comparing it to a plume of a nondepleting noble gas (^{85}Kr). Both plumes were released simultaneously from a common source at an elevation of 1.5 meters. Exposure measurements were made on a grid of samplers at distances of 200 m and 800 m from the source. The sampling array included samplers on 10 towers. It was found that, during traversal of the distance from 200 m to 800 m from the source, 16% of the particulates in the plume was depleted. Depletion was highest near the surface. At breathing level (1.5 m) at 800 m, the crosswind integrated exposure of the particulate plume was found to be only half that of the inert gas plume. (auth)

9557 (BNWL–715–3, pp 74–87) ADDITIONAL METEOROLOGICAL ANALYSES OF SHOT SMOKY, PLUMBBOB TEST SERIES. Davis, W. E.; Oster, C. A.; Scott, B. C.; Thorp, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An analysis of the effect of meteorological conditions on the transport and deposition of fallout from Shot Smoky, an August 31, 1957 nuclear explosion at the Nevada Test Site, was undertaken to explain discrepancies between predicted and measured data. The original meteorological data were found to contain errors. Deletion of these errors resulted in a computed cloud travel path which was in spatial and temporal agreement with aircraft observations. 1967 to 1968 Shot Smoky research demonstrated that: a correlation of isentropic trajectories of the nuclear debris cloud with meteorological observations of precipitation could explain measured high values in the surface deposition pattern near Rock Springs, Wyoming; the isentropic trajectory technique can predict cloud travel in space and time; and the DELFIC computer program can be used to compute the close in (<200 km) deposition patterns for Shot Smoky with an accuracy of deposition centerline location of within 5 km up to a distance of 170 km. (L.C.L.)

9558 (BNWL–715–3, pp 88–92) PARTICLE DEPOSITION WITHIN A CURVED SAMPLING PROBE. Sehmel, G. A.; Schwendiman, L. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Particle deposition was measured in 4.7 to 5.8-in. lengths of 0.135 to 0.40 in. ID tubing formed on a 4.4 in. radius of curvature. For a constant sampling velocity, the deposition increased with an increase in particle size and a decrease in tubing ID. For a constant tube ID, deposition increased with both flow rate and particle size until re-entrainment became important. For transition flow between laminar and turbulent, the deposition was minimum for an intermediate Reynolds number for any constant particle size for which re-entrainment was not important. The deposition was significant for all flow rates and must be considered in interpreting the data for any sample passed through a curved tube in either laminar or turbulent flow. (auth)

9559 (BNWL–715–3, pp 92–5) EFFECT OF SAMPLING PROBE DIAMETER ON SAMPLING ACCURACY. Sehmel, G. A.; Schwendiman, L. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Isokinetic sampling of particles from an air stream is regarded as essential for greatest accuracy. Errors can, nevertheless, result from several sources even when the isokinetic condition is maintained. One such source is the size and shape of the sampling probe. A study was carried out in which uranine particles of a single size (1 to 28 μ diam) were isokinetically sampled through 0.135, 0.210, 0.245, and 0.402 in. ID probes whose inlets were located on the axis of a 2.81 in. ID vertical tube. Sampling velocities from 18.0 to 19.6 ft/sec were equal to the maximum centerline velocities of the sampled tube. The measured concentrations from the sampled air ranged from about 0.8 to 1.2 times the average concentrations in the sampled tube. The measured concentrations are a function of the probe diameter and also are affected by the preferentially enhanced concentration of large particles in the region next to the sampled tube wall. (auth)

9560 (BNWL–715–3, pp 96–100) PARTICLE COLLECTION EFFICIENCIES ON WIRES. Sehmel, G. A.; Schwendiman, L. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Collection efficiencies of monodispersed 4 to 27 μ uranine particles were determined for 0.020 in. diam wires for an air velocity of 18.6 ft/sec. The wires were covered with a thin layer of petroleum jelly. Collection efficiencies decreased as the projected wire area covered by particles increased above about 1%. This decrease has not been previously reported and may explain some of the scatter in literature values of impaction efficiencies. (auth)

9561 (BNWL–715–3, pp 103–8) PARTICLE DEPOSITION VELOCITIES AND PARTICLE CONCENTRATION PROFILES ABOVE THE DEPOSITION SURFACES. Sehmel, G. A.; Schwendiman, L. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Particle deposition was measured for turbulent flow in 1.152 in. ID aluminum tubes. Simultaneously, particle concentration was measured as a function of distance from the deposition surfaces. Since the concentration may be maximum near the tube surface, the deposition is a more complex function of the observed concentration profiles than could be ascribed to simple diffusion models. Measurements of concentration profiles with observed deposition are needed to understand more fully the mechanisms of particle deposition. (auth)

9562 (BNWL–715–3, pp 109–13) ATMOSPHERIC TURBULENCE STUDIES. Elderkin, C. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Research on atmospheric boundary layer turbulence continued with both empirical and theoretical studies. The theoretical work dealt with diabatic effects on spectral shapes and shifts. The assumptions made and calculation methods used are explained, and measured spectra are compared with the magnitude of spectral estimates in the inertial subrange. The empirical work dealt with improved instrumentation and data collection procedures which will provide temperature fluctuation data simultaneously with three-wind component data for conditions of large stability and instability. (L.C.L.)

9563 (BNWL–715–3, pp 113–20) COMPARISON OF TURBULENCE SPECTRA FROM HANFORD, WASHINGTON, AND LIBERAL, KANSAS. Elderkin, C. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The turbulence spectra for each of the three wind components measured under a variety of wind speed and stability conditions at Hanford, Washington are compared with the spectra for a single test in slightly unstable conditions at Liberal, Kansas. The instrumentation and procedures used to obtain the data are described. The results show considerable agreement in the two sets of data, and indicate that the considerable difference in surface roughness at the two sites has no noticeable effect on the spectra for unstable conditions. Further comparisons of the spectra at the two sites is recommended, particularly for stable conditions. (L.C.L.)

9564 (BNWL–715–3, pp 120–7) GENERAL RELATION BETWEEN AUTOCORRELOGRAMS AND VARIANCE. Hinds, W. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The statistics of randomly fluctuating variables have long been useful in analyzing atmospheric motions and behavior. The mathematical results of smoothing the random variable before the statistics are calculated are examined, and calculated values are compared with measured data. It is concluded that this approach to calculating the variance of an increasingly smoothed variable leads to workable results with simple equations, and that this statistical method may provide a usable tool for working with rather complex functions and relations. (L.C.L.)

9565 (BNWL–715–3, pp 128–40) EXPERIMENTAL STUDIES IN PRECIPITATION SCAVENGING. Dana, M. T.; Wolf, M. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Results are presented from six tests which measured the quantity, rate, and surface distribution of particle deposition from aerosols which contained silver iodide or fluorescein and which were released under various precipitation conditions. The mass removed by dry deposition and by washout in each test and the effect of precipitation rate on the washout coefficients were calculated. Further tests are recommended. (L.C.L.)

9566 (BNWL–715–3, pp 140–9) STUDIES OF PRECIPITATION ELECTRICAL CHARGE. Dana, M. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Field observations of the electric charges of non-thunderstorm precipitation were carried out at three locations in Washington state. These studies are of potential importance to an understanding of precipitation scavenging mechanisms, particularly when submicron particulates are involved. The instrument system used for electric charge measurements is described. The measurements are tabulated along with complete meteorological and rain drop size data for each sample measured, and data on charge distribution for several samples are plotted. The experimental results are compared with precipitation charging theory and found to be in qualitative agreement, although the magnitudes of electric charge were substantially higher than those predictable from ionic diffusion and coagulation mechanisms. (L.C.L.)

9567 (BNWL–715–3, pp 150–3) IMPROVEMENTS IN RAINDROP CHARGE MEASURING SYSTEM. Ratcliffe, C. A.; Hoitink, N. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Improvements incorporated into the raindrop charge measuring system used in atmospheric studies reduced transducer microphonics, improved charge induction geometry, reduced adverse environmental operating characteristics, and increased the charge sensitivity. The use of an electrostatic pen recording method allowed system operation under adverse climatic conditions. Extensive field tests, on a continuing basis with power obtained by using batteries for the electronics and a portable ac generator for the recording equipment, evidenced marked operational improvement. (auth)

9568 (BNWL–715–3, pp 154–64) PRECIPITATION SCAVENGING OF SUBMICRON PARTICLES: A THEORETICAL ANALYSIS. Slinn, W. G. N. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A theoretical analysis is made of precipitation scavenging of extremely small particles (radii from 10 to 1000 Å) and how such particles are washed out of the atmosphere by rain of given intensity and of given raindrop size distribution. Equations are developed for particular solutions, for approximate solutions, and for a heat transfer analogy. This analysis leads to the conclusion that inertial effects are insignificant if the particle radius is less than 0.1 μ, and that heat transfer data are expected to be valuable for calculating the contribution to the washout coefficient from convective diffusion. (L.C.L.)

9569 (BNWL–715–3, pp 165–70) PRECIPITATION SCAVENGING OF SUBMICRON PARTICLES: A COMPARISON OF THEORY WITH FIELD RESULTS. Hagen, D. I. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Washout coefficients were measured in the field for the scavenging by rain of silver iodide particles purported to be smaller than 0.1 μ. The field results are compared with values calculated from diffusion theory. It was shown that, by ignoring electrical effects and assuming perfect retention of the particles by the drop, the washout equation becomes similar to that used by Engelmann to predict the washout of perfectly soluble gases, and, within experimental error, agrees with the field results. (L.C.L.)

9570 (BNWL–715–3, pp 171–83) CONVECTIVE DIFFUSION EQUATION FOR THE SCAVENGING OF SUBMICRON PARTICLES. Slinn, W. G. N. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Washout by rain of submicron particles of radii from 10 to 1000 Å is discussed, and a method for mathematically describing the stochastic force on a Brownian particle, i.e., the convective diffusion equation for the scavenging of submicron particles, is derived. (L.C.L.)

9571 (RISO–180) ENVIRONMENTAL RADIOACTIVITY IN DENMARK IN 1967. Aarkrog, A.; Lippert, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). June 1968. 91p. Dep.

The measurement of fallout radioactivity in Denmark in 1967 is reported. ^{90}Sr was determined in samples from all over the country of precipitation, soil, ground water, seawater, grass, dried milk, fresh milk, grain, bread, potatoes, vegetables, fruit, total diet, drinking water, and human bone. Futhermore ^{90}Sr was determined in local samples of air, rain water, grass, sea plants, fish, meat, and human milk. ^{137}Cs was determined in milk, grain products, potatoes, vegetables, fruit, total diet, meat, and human milk samples, and ^{137}Cs was measured by whole-body counting in persons from a control group. Estimates of the mean contents of radiostrontium and radiocaesium in the human diet in Denmark in 1967 are given. The γ-background was measured regularly. Regular surveys of environmental samples are reported. (auth)

9572 SHORT-RANGE DATING OF FRESH NUCLEAR DEBRIS BY THE ACTIVITY RATIO OF ^{133}I TO ^{131}I. Satobayashi, Takeshi; Suzuki, Toshio; Koyama, Seitaro (Univ. of Niigata, Japan). Bull. Chem. Soc. Jap., 41: 2796–7(Nov. 1968).

Since ^{133}I and ^{131}I decay, with 20.8-hr and 8.05-day half-lives, to ^{133}Xe and ^{131}Xe, respectively, the $^{133}I/^{131}I$ activity ratio provides a radioactive clock very sensitive to small differences in time. Highly-radioactive fallout particles and rainwater samples were collected at Niigata between December 30, 1966, and January 2, 1967, and the activity ratios of the ^{133}I to ^{131}I as a function of time were plotted. It was concluded that when any kind of fresh nuclear debris is found shortly after a nuclear explosion, either the $^{97}Zr/^{95}Zr$ or $^{133}I/^{131}I$ method can be used to determine readily the age of the fresh nuclear debris with sufficient accuracy. (D.H.M.)

9573 SNAP ^{238}Pu FALLOUT AT ISPRA, ITALY. de Bortoli, M. C.; Gaglione, P. (Joint Nuclear Research Center, Ispra, Italy). Health Phys., 16: 197–204(Feb. 1969).

Plutonium determinations were carried out monthly on air filter samples (1966 and 1967) and on deposition samples (1967) with the aim of following the arrival to the ground of the SNAP-9A ^{238}Pu fallout. The results of the measurements show that during the summer of 1967 the ^{238}Pu activity attained about half that of weapon ^{239}Pu. In terms of concentration, the activity maxima were 2.8×10^{-5} pCi/m^3 in air and 3.6 μCi/km^2 in deposition. (auth) (UK)

9574 RADIOACTIVITY OF THE ATMOSPHERE AND HYDROSPHERE. Lal, D. (Tata Inst. of Fundamental Research, Bombay); Suess, Hans E. Annu. Rev. Nucl. Sci., 18: 407–34 (1968).

Radioactive nuclear species occurring in the natural environment on the surface of the earth can be classified in three categories: the primary radionuclides, i.e., nuclides which have survived since the time when the elements were formed, and their daughter nuclides; cosmogenic radionuclides, which are formed continuously by the interactions of cosmic-ray particles with matter; and artificial radionuclides, which have been introduced by human activities such as nuclear weapons detonations, nuclear power plant operations, and scientific experiments. A summary is given of the present knowledge of these three categories of radioisotopes which occur in the atmosphere and hydrosphere, and the usefulness of radioisotopes to various fields of research, such as tracer studies in the earth sciences, is discussed. (L.C.L.)

Mineralogy and Exploration

9575 (TID–24871) URANIUM EMPLACEMENT AT GARNET RIDGE, ARIZONA. Gavasci, Anna T.; Kerr, Paul F. (Columbia Univ., New York). [1966]. 61p. Dep. CFSTI.

The uranium occurrence at Garnet Ridge is closely associated with a breccia dike and nearby are large collapse features as well as heaps of metamorphic and igneous boulders foreign to the igneous intrusives of the area. The uranium-bearing host rock, Navajo Sandstone, is ordinarily inhospitable for uranium precipitation and is suggestive of epigenetic origin. Mineralogical and petrographic studies combined with field evidence indicate that boulder heaps represent the eroded throats of ejection vents, originating deep within the basement, which rise through upper Pre-Cambrian as well as Mesozoic and Paleozoic formations. Field evidence indi-

cates that the collapse, with a chaotic display of tilted and broken strata, followed the formation of the vents and the intrusion of the breccia dikes into Navajo Sandstone (Jurassic). Pyrope, with contents of almandite, grossularite, and andradite is a prominent constituent of rocks in both the ejected blocks and the breccia dikes. Gases related to deep-seated igneous activity are believed responsible for the turbulent forces that elevated and rounded the blocks to boulder-like forms. (J.C.W.)

9576 (TID-24884) ORIGIN OF PLATEAU URANIUM ORES: WITH EMPHASIS ON MINERALIZATION AND ALTERATION. Progress Report for 1968. (Columbia Univ., New York. Dept. of Geology). Nov. 1968. Contract AT(30-1)-1936. 11p. Dep. CFSTI.

The genesis of uranium deposits of the southern part of the Colorado Plateau is discussed. Evidence indicates that uranium deposition in the Grants area occurred during the Jurassic, but after a considerable interval following deposition of the sediments. Observations at the southern end of Lisbon Valley appear to indicate that Cu deposition has occurred as a separate period from U deposition. Studies at Orphan Mine and Kane Creek point to moderately low temperature accumulations of uranium in deposits with a considerable vertical extension. Three hypotheses exit to describe the derivation of uranium over the Colorado Plateau. (J.C.W.)

Oceanography

Refer also to abstracts 9314, 9574, and 9928–9930.

9577 (CEA-R-3587) CONTRIBUTION TO THE STUDY OF MAXIMUM LEVELS FOR LIQUID RADIOACTIVE WASTE DISPOSAL INTO CONTINENTAL AND SEA WATER. TREATMENT OF SOME TYPICAL SAMPLES. Bittel, Robert; Mancel, Joel (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Oct. 1968. 33p. (In French). (EUR-3876). Dep.

The most important carriers of radioactive contamination to man are foodstuffs, ingested water, and inhaled air. In accordance with the recent recommendations of the ICRP, it is proposed to substitute the idea of maximum levels of contamination of water to the MPC. In the case of aquatic food chains, knowledge of the ingested quantities and of the concentration factors for food or water permit the determination of these maximum levels, or to find a linear relation between the maximum levels in the case of two primary carriers of contamination (continental and seawaters). The notion of critical food-consumption, critical radioelements, and formulas for waste disposal are considered in the same way, taking care to attach the greatest possible importance to local situations. (auth)

Seismology

Refer also to abstracts 9601 and 9672.

9578 (JAB-99-39) STOCHASTIC SIMULATION OF SITE RESPONSE TO EARTHQUAKES AND UNDERGROUND EXPLOSIONS. Phase I. (Blume (John A.) and Associates Research Div., San Francisco, Calif.). Nov. 1968. Contract AT(26-1)-99. 60p. Dep. CFSTI.

Results are reported for the initial phase of study on ground motion prediction and simulation. The auto-correlation functions and the power spectral density functions were obtained for a total of fifteen ground motion records. It was proposed to use these functions to characterize ground motions and to form a basis for determining the equivalent ground-layer filter for the desirable stochastic model. Linear filters to represent the ground transfer characteristics of the seismic stations were studied. Single-degree-of-freedom solutions for each of the fifteen seismic stations were obtained, expressed in terms of the predominant frequencies and the effective damping for the sites of each station. From results of the analysis obtained in this investigation, the following conclusions may be drawn: the auto-correlation function and the power spectral density function of existing ground motion records (earthquakes and nuclear undergound explosions) resemble those of a narrow-band process; from the viewpoint of stochastic simulation, the auto-correlation function or the power spectral density function can be used to characterize the ground motion records; the power spectral density function of existing ground motion data for a given station may be used as the basis to generate a filtered, stationary stochastic model for that station; and by matching the power spectral density function of an existing ground motion record to that of the output of a single (or multi) degree-of-freedom system to white noise, the equivalent ground predominant frequencies and dampings can be determined. (auth)

9579 PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON WAVE PROPAGATION AND DYNAMIC PROPERTIES OF EARTH MATERIALS HELD ON AUGUST 23–25, 1967 AT ALBUQUERQUE, NEW MEXICO. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968. 1009p. $20.00. (CONF-670804).

Seventy-three papers given during the International Symposium on Wave Propagation and Dynamic Properties of Earth Materials, held at Albuquerque, New Mexico, August 23 to 25, 1967, are presented. Separate abstracts were prepared for 14. The remaining 59 papers contain information not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 9544, 9580–9590, 9667, and 9672.

9580 EFFECT OF SOIL PROPERTIES ON THE ATTENUATION OF AIRBLAST-INDUCED GROUND MOTIONS. Hendron, Alfred J. Jr.; Auld, Harry E. (Univ. of Illinois, Urbana). pp 29-47 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23–25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

Existing design procedures for predicting airblast-induced ground motions in the superseismic region utilize a stress attenuation factor, α, which was obtained by considering the spatial dispersion occurring in an elastic half-space from a static representation of the nuclear airblast loading. The attenuation of vertical stress versus depth was studied as a function of the energy absorption characteristics of the soil. Comparisons are made among these results, existing design procedures, and field test data. It is shown that the hysteretic nature of soils and the nature of the airblast input are the primary variables governing attenuation of peak vertical stress in the superseismic region. Results are given for a wide range of variables which can be used directly in calculating design estimates of ground motions. (auth)

9581 FINITE ELEMENT SOLUTION FOR WAVE PROPAGATION IN LAYERED MEDIA CAUSED BY A NUCLEAR DETONATION. Costantino, C. J. (IIT Research Inst., Chicago); Wachowski, A.; Barnwell, U. L. pp 59-70 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23–25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

A computer program has been developed to treat the response of general two-dimensional continuum problems subjected to dynamic loadings caused by a nuclear detonation. The code, termed the SLAM (Stress Waves in Layered Arbitrary Media) Code for identification, is based upon the finite element approximation to the problem as opposed to the more typical finite difference approximations that have been used for this class of problem. This approach has the specific advantage of being able to treat in a rather simple fashion the complex geometric site configurations (layering, inclusions, outcropping, etc.) usually encountered at hardened facility sites. The numerical results presented are for rather idealized problems, namely the response of horizontally layered elastic materials subjected to a 1-Mt explosion. The computed responses indicate that the effect of the soil layering is to induce a highly oscillatory free-field motion, which may have significant implications in the design of isolation systems for internally housed equipment. Direct induced ground-shock effects appear to be significant, and even overshadow the air-induced motions, in the higher overpressure ranges, particularly for the horizontal motions. (auth)

9582 DYNAMIC SOIL BEHAVIOR IN TERMS OF RESPONSE SPECTRA. Kondner, Robert L. (Loyola Coll., Baltimore. Univ. of Maryland, College Park). pp 293-304 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23–25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

Unified elastic and total strain response spectra for cohesive soil are formulated covering a time spectrum from less than 1 millisecond to more than 10^4 min, moisture content spectrum from 18 to 41% corresponding to a strength spectrum of 0.3 kg/cm^2 to 15 kg/cm^2, applied stress spectrum of 0.7% of soil strength all the way to failure, and strain spectrum from 0.0003 to more than 22%. Blast, pulse, creep, and vibratory steady-state test results are analyzed and correlated in terms of response spectra. Theoretical and experimental results are compared. Stress (σ), strain (ϵ), strength (q), and consistency effects are combined using a nondimensional compliance parameter (ϵ q/σ). Nonlinear effects are

included. Elastic and plastic strains can be determined using the vibratory tests. (auth)

9583 HAND SOLUTION OF ONE-DIMENSIONAL INELASTIC WAVE-PROPAGATION PROBLEMS. Abbott, Phillip A. (Univ. of New Mexico, Albuquerque). pp 371-92 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

A method for obtaining a numerical solution to a wide variety of one-dimensional inelastic wave-propagation problems is discussed. The emphasis is on solutions to problems involving air-induced shock propagation in soil or rock resulting from a nuclear detonation under superseismic conditions. Emphasis is also placed on hand solutions obtained using a desk calculator and drafting instruments. The method is quite versatile in that it allows any pressure or kinematic condition at a boundary, any nonlinear and hysteretic material stress-strain curves, and any layering of different materials. The principal limitations of the method are that it does not treat viscoelastic material behavior, problems involving more than one-dimensional behavior, and problems in which strains and particle velocities are not relatively small. Two example problems are included: one shows the formation of a shock in a homogeneous medium, and the other shows wave propagation through a layered medium. (auth)

9584 AIR-INDUCED GROUND SHOCK: A ONE-DIMENSIONAL THEORY. Batdorf, S. B. (Aerospace Corp., San Bernardino, Calif.). pp 423-32 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

The most frequently used method for estimating air-induced soil pressures and motions is based on an attenuation of pressure with depth, which has no satisfactory theoretical foundation; and empirical modifications to one-dimensional elastic wave propagation theory for the estimation of motions. The method presented assumes that the primary source of pressure attenuation is plasticity, and introduces a two-parameter stress-strain curve which represents in first approximation the departure of the medium from linear elasticity. Simple expressions are then derived for wave velocity, velocity of peak stress, maximum soil velocity, and maximum acceleration. The analysis provides a theoretical foundation for attenuation with depth, and shows how stress-dependent factors can be found to replace the stress-independent empirical constants currently in use. (auth)

9585 GROUND VIBRATION CHARACTERISTICS OF MESITA DE LOS ALAMOS. Keller, M. Dean (Los Alamos Scientific Lab., N. Mex.); Foster, Eric S.; Werner, Frank H. pp 469-82 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

The foundation material which must support the Los Alamos Meson Physics Linear Accelerator is a welded tuff of volcanic origin. Its physical properties are neither perfectly elastic nor inelastic, and its characteristics with respect to amplification or attenuation of vibrations were unknown to a satisfactory degree. Prior to design of critical components for the Meson Physics Linear Accelerator, it was necessary to determine these characteristics with sufficient reliability to provide for economical designs of buildings and critical machine components. Those forces which could be duplicated, such as heavy truck traffic and impact loading, were duplicated and the vibrations resulting therefrom were recorded. Natural microseisms were recorded. High explosives were detonated on Mesita de Los Alamos, and the relationship between size of charge, distance, frequency, velocity, acceleration, displacement, and Fourier spectra coefficients was established. The results obtained from these tests will be used in the dynamic analysis of components comprising this facility. Two tests of this series, the impact tests and the high-explosive detonation tests, are described. (auth)

9586 ELASTIC WAVE PROPAGATION: A COMPARISON BETWEEN FINITE ELEMENT PREDICTIONS AND EXACT SOLUTIONS. Shipley, S. A.; Leistner, H. G.; Jones, R. E. (Boeing Co., Seattle). pp 509-19 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

Five problems of elastic wave propagation, for which exact solutions are available, are considered. Numerical solutions for these problems are calculated by means of the finite element technique. The numerical results are compared with exact solutions. Capability of this calculation procedure to achieve solutions to problems of varying degrees of complexity is assessed. A brief description of the finite element technique and the models presently in use for calculation of wave response in layered media is presented. (auth)

9587 ENERGY DISSIPATION IN A SOFT CLAY. Krizek, Raymond J.; Franklin, Arley G. (Northwestern Univ., Evanston, Ill.). pp 797-807 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

The energy dissipation characteristics of a soft kaolin clay are measured by analyzing hysteresis loops produced by subjecting a clay specimen to a harmonically applied, relatively homogeneous, torsional shear strain, and measuring the resulting stress response. Phase angles between stress and strain are measured, and the energy losses determined by using these phase angles in combination with linear viscoelastic theory are found to be slightly more than the energy losses measured from the hysteresis loops, where no assumption regarding material behavior is required. Although actual magnitudes of energy losses by the two methods agree reasonably well, the clay is found to exhibit a definite nonlinear behavior and the nature of the energy dissipation may be quite different; for example, the shape of the experimentally measured hysteresis loop is quite different from that of a linearly viscoelastic material. Energy dissipation is found to be relatively independent of frequency from approximately 0.1 to 30 cps; thus, for the particular material tested, a constant tan δ viscoelastic model seems to offer a reasonable first-order approximation of its behavior for purposes of determining peak stress attenuation and change in wave shape for problems involving wave propagation. (auth)

9588 A VIBRATORY TECHNIQUE FOR DELINEATING SUBSURFACE FRACTURE ZONES RESULTING FROM DETONATIONS. Ballard, R. F. Jr. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). pp 891-903 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

Site investigations were conducted at two locations, the sites of the DUGOUT and CHARLIE events, at the Nevada Test Site, for the purpose of evaluating the dynamic in situ technique as a means of determining the boundaries of craters produced by explosive detonations. Shear-wave velocities at the location of the DUGOUT event were determined by vibration tests. From the vibration data, it was possible to make a cross-sectional contoured plot of shear-wave velocities which showed the extent of subsurface disturbances. Vibration traverses were also run at the CHARLIE site; these data were used in mapping the limits of the blast-induced fractures, and in this case actually defined the true crater limits. These results confirmed the feasibility of the dynamic in situ technique as a means of defining the subsurface zonal conditions in the immediate vicinity of craters resulting from high-yield detonations. The study also showed the adaptability of the equipment for this use. (auth)

9589 A PROCEDURE FOR DETERMINING ELASTIC MODULI OF IN SITU SOILS BY DYNAMIC TECHNIQUES. Maxwell, A. A.; Fry, Z. B. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). pp 913-19 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

A procedure to determine the elastic moduli of in situ soils is described. The basic theory of wave propagation and relations of the elastic parameters are presented. The equipment and measuring techniques are described in detail. The procedure employs the determination of the velocity of waves propagated at known frequencies along the exposed surface of the soil. The determination of the velocity of wave propagation over a range of frequencies provides a means of deriving the elastic constants of a soil. The

method described herein has an advantage over conventional soil tests in that it is applied to in situ soil and enables a considerable area to be investigated rapidly. The use of the information collected is also described herein. From the field data collected the elastic constants, shear modulus G, compression (Young's) modulus E, and Poisson's ratio ν can be computed. The values determined can be related to depth using one-half the surface wavelength as the depth factor. The characteristics may then be used in the design and/or evaluation of foundations for structures. (auth)

9590 THRESHOLDS OF DAMAGE DUE TO GROUND MOTION. Jackson, Melvin W. (Holmes and Narver, Inc., Los Angeles). pp 961-9 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Trianda-filidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

Thresholds of damage due to ground motion are summarized. Values based on peak particle acceleration, velocity, displacement, period, and duration have been compared in relation to experience from quarry blasting, nuclear detonations, and earthquakes. Triggering action, as an explanation of damage, and statistical evaluation of damage involving a large number of structures are considered. The use of building codes to establish a damage threshold was considered not valid. Damage thresholds based on structural response spectra may offer potential promise but sufficient data have not been developed for meaningful values. The source of potentially valuable future information from the Los Angeles area is indicated. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 9540, 9557, 9578, 9580–9584, 9586, 9588, 9649, and 9670.

9591 (NVO–99–27) SPECTRAL RESPONSE TO GROUND DISPLACEMENT AT HATTIESBURG, RESULTING FROM NUCLEAR EVENT SALMON. Blume, John A. (Blume (John A.) and Associates Research Div., San Francisco, Calif.). Mar. 1968. Contract AT(26-1)-99. 31p. Dep. CFSTI.

Spectral response is developed from a record of ground displacement in Hattiesburg, Mississippi, resulting from the SALMON event, Project DRIBBLE, an underground nuclear explosion near Baxterville, Mississippi in October 1964. No acceleration records are available for Hattiesburg. It was found that peak response in the short period range could be reasonably estimated using as little as one second of selected motion from the entire record. A stochastic model of the key portion of the ground motion was constructed with a few sine pulses which essentially duplicate the short period peak response. (auth)

9592 (PNE–514) PROJECT PRE-SCHOONER II: GROUND SHOCK MEASUREMENTS. Final Report. Davis, Lawrence L. (Beers (Roland F.), Inc., Alexandria, Va.). Apr. 1966. Contract AT(29-2)-1163. 61p. Dep. CFSTI.

An instrumentation plan was designed for the purpose of collecting seismic data which would be useful for making future predictions for the Schooner event. Peak ground motions were predicted at each station so that instruments could be set at the proper recording levels. Good data were obtained at each station. The velocity data from six stations which employed tape recording were processed to remove the frequency dependency of the instrument response, and acceleration and displacement were derived from the corrected velocity recordings. Additionally, the velocity recordings were subjected to band-pass filtering and amplitude-frequency relations were obtained. The observed peak values of ground motion are presented in tabular and graphical form. Where appropriate, least-squares regression equations were fitted to the observed data. Comparisons of the observed data with the predictions show that in all but one case the predictions were low. The frequencies associated with the largest velocity amplitudes ranged from about 2 to 9 cps. (auth)

9593 (SC-DC–68–2533) AIRBLAST FROM PLOWSHARE PROJECTS. Reed, Jack W. (Sandia Labs., Albuquerque, N. Mex.). [1968]. 29p. Dep. CFSTI.

The characteristics of airborne shock waves caused by underground nuclear explosions in Plowshare Projects are examined, and the effects of such airblasts are predicted. (L.C.L.)

9594 (SC-R–68–1874) ON RADAR PULSE SCATTERING FROM NONHOMOGENEOUS IONIZED MEDIA. Harrison, Charles W. Jr.; Aronson, Eugene A. (Sandia Labs., Albuquerque, N. Mex.). Aug. 1968. 29p. Dep. CFSTI.

A review is presented of some of the preliminary work carried out at the Sandia Laboratories relating to pulse radar from ionized media, such as fireballs resulting from nuclear explosions and the wakes of high-speed re-entry vehicles. In all cases the objective was to retrieve the envelope of the back-scattered signal correctly related in time to the transmitted pulse, and employ a suitable form of the radar equation to obtain the power available in the receiver load in terms of the transmitter power. The electron density-collision frequency profiles used were based on the efforts of others. In the work completed, the region near the virtual reflection point in the profile was divided into at least 40 slabs which were considered to be infinite in two dimensions and generally of differing widths. In the solution of the boundary value problem in the frequency domain Maxwell's equations were satisfied at every interface. Piecewise constant zoning was used initially. A computer was employed to invert the matrix for determining the reflection coefficient for a given profile. (auth)

9595 (SC-RR–64–1703) AIR VENT: SURFACE MOTION PHOTOGRAPHY. Vortman, L. J. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1965. 59p. Dep. CFSTI.

Results of surface motion displacement-time, velocity-time, and acceleration-time obtained from motion picture photography are presented for one 20-ton shot at a 17.1-foot burial depth and for 256-pound shots at burial depths from just below the surface to containment. All charges were in Frenchman Flat playa. The time after detonation at which gas venting occurs for the deeper bursts in the Frenchman Flat playa is found to be generally earlier than would be expected from a burst at the same depth in desert alluvium. In this respect, the playa behaves more like a soft rock in which cracks open up early in the motion and allow venting of the high explosive gases to the atmosphere. For shallow burial depths, the time of venting seems to fall closer to that for alluvium. Initial vertical velocities of the free surface as determined by this project are higher in playa than in alluvium. Based on the velocities determined by this project, one calculates that earth stresses a given distance from the charge are less in playa than in alluvium but that stresses at the crater edge are higher because of the smaller crater in playa than in alluvium. (auth)

9596 (SC-RR–64–1704) PROJECT AIR VENT: CRATER STUDIES. Flanagan, T. J. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1966. 98p. Dep. CFSTI.

Project Air Vent consisted of 30 high explosive cratering shots in the playa of Frenchman's Flat in Area 5 at the Nevada Test Site. The largest shot, with a charge weight of 40,000 pounds was buried at a depth of 17.1 feet. Eleven others were half-buried with charge weights varying from 64 to 6000 pounds. The remaining 18 were buried at varying depths, all with a charge weight of 256 pounds. The data gathered from the 11 surface shots indicate that scaling of apparent crater radius is proportional to the 0.359 power of the charge weight. If the data from the 40,000-pound, Flat Top surface shots are included, the scaling factor becomes 0.369. Craters from the 18 shots at varying depths are generally 20% smaller in apparent radius than comparable shots in Area 10 alluvium. The crater from the largest shot, when compared with the 40,000-pound Stagecoach No. 2 shot in Area 10, is smaller by 5% in apparent radius and depth. (auth)

9597 (SC-RR–68–754) GROUND MOTION PRODUCED BY MIKE SHOT OF OPERATION IVY. Perret, William R. (Sandia Labs., Albuquerque, N. Mex.). Dec. 1968. 60p. Dep. CFSTI.

Ground motion produced by Mike shot of Operation Ivy (Project 6.5) was measured as three components of acceleration at four ground ranges between 8000 and 114,000 feet. Gages were in sand below the water table at depths of about 17 feet. Similar measurements were made on a massive concrete instrument shelter at about 30,000 feet from ground zero. A rough empirical relation was derived for scaled peak ground-transmitted acceleration as a function of scaled ground range and compared with similar data from Operation Greenhouse. Peak vertical acceleration produced by incidence of air shock in the vicinity of the gage station was related empirically to peak air overpressure. These relations are necessarily rough because of the few reliable data available, but are probably adequate for estimating effects of megaton weapon bursts. Acceleration data were converted to velocity-time and displacement-time information. Data correction techniques developed during the processing of Ivy Mike ground motion records are described. (auth)

9598 (UCRL–50489) SIZE-DISTRIBUTION STUDY OF PILEDRIVER PARTICLES. Rabb, David D. (California Univ., Livermore. Lawrence Radiation Lab.). Oct. 1, 1968. 19p. Dep. CFSTI.

Two samples of chimney rubble totalling over 5,000 lb were obtained during the postshot exploration at Piledriver. These samples of broken granite underwent screen analysis, a radioactivity-distribution study, and cursory leaching tests to determine the solubility of specific nuclides. The chimney was 160 ft in radius and 890 ft high. An injection of radioactive melt was encountered at 300 ft from shot point. Radiochemical analyses determined that the yield of the Piledriver nuclear device was 61 ± 10 kt. The two samples were screened into 25 different size-fractions. An average of the particle-size data from the samples showed that 17 percent of the material is between 20 mesh and 1 in.; 40 percent between 1 and 6 in.; and 30 percent between 6 in. and 3 ft. The amount of minus 100-mesh material is less than 1.5 percent. The distribution of radioactivity in different particle size-fractions is inversely proportional to particle size. Small-scale batch-leaching tests showed that 25 percent of the radioactivity could be removed in a few hours by a film-percolation leach using distilled water, 40 percent if dilute acid were used. (auth)

9599 METEOROLOGY IN STUDIES FOR A NEW ISTHMIAN CANAL. Reed, J. W. (Sandia Corp., Albuquerque, N. Mex.); Ferber, G. J. Bull. Amer. Meteorol. Soc., 48: 13-15(Jan. 1967). (SC-R–66-1012).

Feasibility studies are currently underway to indicate whether or not a sea level canal may be dug with nuclear explosives and at less cost than by conventional excavation methods. Safety prob-

lems must be understood before actual excavation may begin. The roles of atmospheric propagation of radioactivity and airblast must be considered in the planning for safe nuclear excavation. Meteorological studies must be conducted to show whether atmospheric conditions may impose uneconomical restrictions on nuclear device yields or excavation firing schedules. (R.C.K.)

9600 BUMINES CHIEF SAYS NUCLEAR BLASTS OFFER KEY TO FUTURE SUPPLY. Kinney, Gene T. Oil Gas J., 64: 44-6(Aug. 15, 1966).

The application of nuclear explosives to the recovery of shale oil and natural gas is discussed. Project Gasbuggy, a cooperative effort between the USAEC and the El Paso Natural Gas Company to investigate the use of nuclear fracturing for the production of natural gas, is described. The use of nuclear fracturing for the production of shale oil is also discussed. (R.C.K.)

9601 AIR-BLAST SUPPRESSION AS A FUNCTION OF EXPLOSIVE-CHARGE BURIAL DEPTH. Vortman, L. J. (Sandia Corp., Albuquerque, N. Mex.). J. Acoust. Soc. Amer., 40: 229-39(July 1966). (SC-R-66-898).

The blast wave from buried explosions consists primarily of a pulse induced by the ground shock followed by another pulse when the explosive gases are vented to the atmosphere. The latter pulse provides the dominant contribution for the shallower burial depths. Air-blast measurements made along the ground surface for 46 chemical explosive and 7 nuclear explosive detonations have shown the peak overpressure of the ground-shock-induced pulse to be about the same for chemical and nuclear explosions in basalt rock as for chemical explosions in alluvial soil. The ground-shock-induced pulse has not been observed for nuclear explosions in soil. The peak overpressure from venting gases is about equal for chemical explosives in basalt rock and alluvial soil. Peak overpressures are higher for nuclear explosions in soil, in part because the cavity pressures at the time of venting are higher; peak overpressures are lower for nuclear explosions in rock, presumably because less gas is formed and because the pulse from venting gas coincides with the negative phase following the ground-shock-induced pulse, thus reducing overpressure amplitude. Measurements have been made over a sufficiently large range of charge burial depths that a pattern of air-blast suppression with charge burial can be presented. (auth)

9602 REVIEW OF NUCLEAR WEAPONS EFFECTS. Brode, Harold L. (RAND Corp., Santa Monica, Calif.). Annu. Rev. Nucl. Sci., 18: 153-202(1968).

Since nuclear explosions provide access to a realm of high-temperature and high-pressure physics not otherwise available on a macroscopic scale on earth, this unique environment is studied to possibly provide a further understanding of nature. Nuclear explosion physics is reviewed and formulas for estimating the various transient phenomena are presented. These phenomena include: the characteristics of the fire ball such as size, temperature, density, pressure, and shock configurations; the nuclear and thermal radiations and electromagnetic pulses which results from a nuclear explosion; the blast effects in terms of both air and ground motions; and fallout. (L.C.L.)

9603 NUCLEAR PLAN. pp 274-85 of Panama: Four Hundred Years of Dreams and Cruelty. Howarth, David. New York, McGraw-Hill Book Co., 1966.

The history of the Panama Canal Zone is discussed. The need for another canal across the Isthmus to handle large ships, e.g., aircraft carriers is described. Possible routes for the canal and the probable cost of each using nuclear excavation technology are presented. Two problems must be overcome before nuclear excavation is possible: the agreement of the signatories of the Nuclear Test Ban Treaty must be obtained and the people living in the area must be persuaded that the operation will be safe. (R.C.K.)

9604 PANAMA: FOUR HUNDRED YEARS OF DREAMS AND CRUELTY. Howarth, David. New York, McGraw-Hill Book Company, 1966. 297p.

A separate abstract was prepared for Chapter XII on the use of nuclear explosives for the excavation of another Isthmian canal. (R.C.K.)

For an abstract of the individual chapter see: 9603.

9605 MULTIPLE FIRES FROM A NUCLEAR EXPLOSION. Stannard, A. F. B. (Emergency Measures Organization, Ottawa). EMO (Emergency Meas. Organ.) Dig., 7: 14(Apr. 1967).

Although everything within several miles of a nuclear explosion will be destroyed, blast damage to homes located at somewhat greater distances will not be severe enough to make them uninhabitable. In fact, many homes outside the blast radius can be saved if they are adequately prepared and efficiently organized. Because the heat from a nuclear explosion is so intense these homes will burn unless they are equipped with fire extinguishers. Research shows that in 10 minutes 50 percent of room fires pass the self-help (a team of two people equipped with fire extinguishers) stage, and in 20 minutes this proportion rises to more than 70 percent. After a blast has taken effect a family will have 2 to 5 minutes to put out the fire. This is a powerful argument for each homeowner to become familiar with firefighting techniques and equipment. (Arms Contr. Disarmament)

Facilities and Equipment

Refer also to abstracts 10200, 10578–10581, 10893, and 11390.

9606 (BNWL-715-3, pp 101-3) WIND TUNNEL FOR PARTICLE DEPOSITION MEASUREMENTS. Sehmel, G. A.; Schwendiman, L. C.; Horst, T. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A wind tunnel was designed and installed for measuring particle deposition onto surfaces. The tunnel has a 2×2 ft cross section, with a test section 30 ft long. (auth)

9607 (BNWL-715-3, pp 190-4) PORTABLE LABORATORY. Rieck, H. G.; Wogman, N. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The design and operation of a portable laboratory for remote-site use in atmospheric physics, fallout, and other studies are described. The laboratory consists of an air-conditioned truck-type trailer which is outfitted with facilities for sampling, for sample processing in a chemical laboratory area, and for measuring radioactivity in a counting room. (L.C.L.)

9608 (ISO-875) CPD JETS: STANDARD GROUPINGS AND PROCESS SPECIFICATIONS. Nordahl, J. H. (Isochem Inc., Richland, Wash.). May 31, 1967. 40p. Dep. CFSTI.

Standard group specifications were revised and updated as required and the list of Purex jet applications also updated. Future orders for CPD jets should be made in accordance with the standard group data listed. Listings of Purex jet applications, organized by the equipment number as used on engineering flow diagrams, are given. The data for the standard jet groups are also presented. Certified Performance Data are not included but are maintained and are available on request. (F.S.)

9609 (LMEC-68-1) LIQUID METAL ENGINEERING CENTER (LMEC). Quarterly Technical Progress Report, October–December 1967. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). Sept. 1, 1968. Contract AT(04-3)-700. 159p. Dep. CFSTI.

The Liquid Metal Engineering Center performs numerous tasks in support of the LMFBR program such as: preparing engineering specifications and providing consulting services; maintaining a liquid metals information center; and operating a sodium component testing facility for evaluating the pumps, piping, heat exchangers, bearings, seals, instruments, and materials used. Progress in each of these programs is described. (L.C.L.)

9610 (LMEC-68-13) LIQUID METAL ENGINEERING CENTER (LMEC) QUARTERLY TECHNICAL PROGRESS REPORT, JANUARY–MARCH 1968. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). Oct. 1, 1968. Contract AT(04-3)-700. 156p. Dep. CFSTI.

The Liquid Metal Engineering Center performs numerous tasks in support of the LMFBR program such as: preparing engineering specifications and providing consulting services; maintaining a liquid metals information center; and operating a sodium component testing facility for evaluating the pumps, piping, heat exchangers, bearings, seals, instruments, and materials used. Progress in each of these programs is described. (L.C.L.)

9611 (ORNL-4302) PILOT-SCALE EQUIPMENT DEVELOPMENT FOR PYROLYTIC-CARBON COATING. Pratt, R. B.; Sease, J. D.; Lotts, A. L. (Oak Ridge National Lab., Tenn.). Dec. 1968. Contract W-7405-eng-26. 108p. Dep. CFSTI.

Attainment of low power costs from high-temperature gas-cooled reactors using thorium-uranium-233 cycle depends on the successful development of fuel recycle technology, particularly for coated-particle fuels. A design of a 5-in.-dia coating furnace in which pyrolytic-carbon coatings have been deposited on sol-gel nuclear fuel particles in quantities to 10 kg per day is given. Equipment and processing requirements for future fabrication of ^{233}U-bearing fuels in the Thorium–Uranium Recycle Facility are defined. Primary emphasis is on the particle coating furnace and its operation with supplementary discussion of facilities, processes, and auxiliary equipment. (auth)

9612 (ORNL-TM-2378) ANCHORAGE SYSTEMS IN PRESTRESSED CONCRETE PRESSURE VESSELS; ANCHORAGE ZONE PROBLEMS. Gergely, Peter (Cornell Univ., Ithaca, N. Y.). Jan. 1969. Contract W-7405-eng-26; Subcontract 2852. 49p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

An assessment was made of the current state of knowledge with regard to anchorage design. Although it is shown that theoretical techniques are inadequate when used alone to define the bursting zone associated with anchorages, the conclusion is made that theoretical analysis coupled with experimental analysis will provide satisfactory designs. Recommendations are made to use model analysis for examination of the more complex designs used in PCRV anchorages with attention given to both the bursting and spalling zones. An evaluation was also made of the feasibility of developing a steady state and transient heat transfer computer program for utilization with finite element stress analysis programs. It was concluded that the technique shows promise. (auth)

9613 (SAN-651-71) ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM. Quarterly Progress Report No. 10, July 1–October 1, 1968. Niggemann, R. E. (Sundstrand Aviation-Rockford, Ill.). Oct. 15, 1968. Contract AT(04-3)-651. 71p. Dep. CFSTI.

Activities in a program to develop a power conversion system capable of long duration operation in space are reported. These activities include investigations of the working fluid, bearings, condensate pumps, and boilers. An experimental investigation of the pyrolytic degradation of biphenyl and a eutectic mixture of biphenyl and biphenyl ether, with test runs up to 8500 hr, showed that both fluids had excellent stability at 650°F. At 700°F the eutectic loop showed slightly higher degradation rates at 3000 hr than the biphenyl. The bearing test rig was completed and tests begun, but discontinued due to a misalignment of the motor drive mechanism. Two pump impellers were received for testing, and one was tested for pressure vs. flow and efficiency vs. flow. The eutectic mixture was used in boiler loop tests to determine boiler stability and heat transfer rates. The use of a boiler tube with a flashing orifice was investigated. (L.C.L.)

9614 (SC-RR-68-622) COMPUTER CODE HRS004-7: A QUIKTRAN COMPUTER CODE FOR THE COMPUTATION OF INITIAL REENTRY ANGLE AND VELOCITY OF OBJECTS DECAYING FROM EARTH ORBIT. Spahr, H. R. (Sandia Labs., Albuquerque, N. Mex.). Dec. 1968. 48p. Dep. CFSTI.

QUIKTRAN computer code HRS004-7 calculates the initial reentry angle and velocity of objects decaying from earth orbit. The theory underlying this code is summarized, and the computer program and the input data required are detailed. Use of this code on the QUIKTRAN facility is discussed, and the output from this code is presented for two sample solutions. (auth)

9615 PNEUMATIC PANORAMIC IRRADIATOR. Masefield, J.; Rice, F. G.; Anderson, M. B.; Curnow, E. K. (to Atomic Energy of Canada Ltd.). Canadian Patent 795,894. Oct. 1, 1968.

The irradiation position is separated from the storage position by a shielding mass traversed by one or more meandering tubes. The radioactive material such as ^{60}Co is contained in short pellets so that several of them can move through the meandering tubes without jamming. If the object to be irradiated is long, several short capsules are placed end to end so as to provide a uniform irradiation field. A pneumatic method is used for moving the capsules from the storage position through the upward meandering tubes to the position required for irradiation. A system of magnets and springs is provided for "fail-safe" operation. (F.S.A.)

9616 METHOD AND APPARATUS FOR EXTRACTING A CHARGED PARTICLE BEAM INTO A HIGHER PRESSURE ATMOSPHERE. (to General Electric Co.). British Patent 1,138,905. Jan. 1, 1969. Priority date Jan. 28, 1966, United States.

Equipment and techniques for extraction of charged-particle beams from low-pressure environments to environments of relatively high pressure as is done in electron beam welding and other irradiation processes are described. (B.G.D.)

9617 NUCLEAR POWER: ITS POTENTIAL FOR ALUMINIUM REDUCTION. Kaestle, F. L.; Marsh, W. D.; Bigge, W. G. Light Metal Age, 26: 18–22(Apr. 1968).

The use of nuclear power for Al production is discussed. It was found that in an area using nuclear power there will be a demand for from 700 to 1400 MW. If the reduction plant is integrated with a fabrication plant the demand will be for 850 to 1700 MW. Nuclear power appears to be an appropriate energy source for close integration with Al production plants. For the most economical power the nuclear power units should be in the 500 to 1000 MW range. Nuclear power plants should consist of a few large units. Where available, substantial integration with large utility systems to provide the required reserve capacity is most economical. (F.S.)

9618 DETERMINATION OF COLLECTING AND DETECTING EFFICIENCIES OF VARIOUS FILTERS BY ALPHA-SPECTROMETRY. Kurosawa, Ryuhei (Waseda Univ., Tokyo). Waseda Daigaku Rikogaku Kenkyusho Hokoku, No. 40, 1-8(June 1968). (In Japanese).

Collection and detection efficiencies of the various dust collecting filters depend on the form of distribution of particles in the filter. In order to determine these efficiencies, distribution of the particles was studied by means of alpha energy analysis of alpha particles emanated from the surface of the filter. Experiments were performed by the following procedure. The radon daughter products in air containing about 1×10^4 particles/cm^3 aerosol, were collected with the filter for about 20 min. under a flow rate of 0.3 m/sec., and alpha activities and energy distribution due to captured $^{214}P_0$ in the filter were detected by a silicon semiconductor detector with a collimator. The greater part of the radon daughter products in the air attached to aerosol particles was due to the high mobility of these primary particles. Attaching rate of primary particles is induced by Smoluchowsky's theory of coagulation. Therefore, size distribution of the attached particles may appear between 0.018 and 0.18 μm with peak at 0.06 ~ 0.08 μm under the assumption that the aerosol distribution is normal (distributed between 0.008 and 0.10 μm with peak at 0.03 μm). Distribution form of the aerosol particles in the filter was determined by applying the experimental result to the above mentioned formula. Collection and detection efficiencies of the various filters were calculated by the distribution form of the particles. Collection efficiency for Toyo Roshi No. 5A, Millipore AP–20 and membrane filter (pore size 0.4 μm) equals 83.7%, 99.2% and 99.99%, respectively, and detection efficiency of these filters for alpha ray of $^{214}P_0$ equals 32.2%, 45.4% and 49.1%, respectively. (NSA of Japan)

9619 IMPROVEMENTS IN OR RELATING TO TUBULAR RECUPERATIVE HEAT EXCHANGERS. Chojnowski, Boguslaw; Beckerleg, Bruce Anthony (to Central Electricity Generating Boards). British Patent 1,138,204. Dec. 27, 1968. Filed Nov. 9, 1965.

A recuperative heat exchanger is described which comprises a matrix of tubes arranged in horizontal layers spaced apart and being parallel to one another but transverse to tubes in adjacent layers. Refractory packing forms a saddle between the tubes at each point where tubes cross. Walls containing vertical header ducts surround the matrix, whose tubes extend between ducts in opposite walls. The assembly is particularly applicable to ceramic tube heat exchangers and where these are for operation at high temperatures the walls would preferably also be made of ceramic material. One of the heat exchanger fluids would be passed through the main body of the assembly over the tubes and the other fluid would be passed through the tubes and the header ducts. The header ducts can be arranged to form connections between successive cross passes in matrix designs with more than one cross pass, i.e., the fluid is made to flow through at least two tubes between the inlet and outlet. The advantage of this assembly arrangement is said to lie in the relatively short tubes that need be used and in the rigidity of the structure. (UK)

9620 PNEUMATIC POSITIONING SERVOMECHANISM ARRANGEMENT. Perrin, Guy (to Commissariat a l'Energie Atomique). British Patent 1,140,185. Jan. 15, 1966. Priority date June 21, 1966, France.

A pneumatic servomechanism positioning arrangement is described which may be operated up to ambient temperature of 120°C, in locations where electrical equipment is not safe, and for large displacement of mechanical members. The arrangement consists of 2 bellows in opposition, one for receiving a pneumatic control signal and the other for receiving a negative feedback signal. A lever arm for assuming a position of balance when pressures in the bellows are equal, 2 nozzles in opposition on each side of the lever arm, 2 pneumatic relays and a rotary pneumatic motor for rotating a controlled member. A second lever arm and nozzle with relay are provided to actuate a rotary motor. Any signal which moves the first lever arm away from the position of balance causes the motor to rotate. The angle through which the motor rotates is the same as the angle through which the controlled member has rotated. This angle is proportional to the variation in the pneumatic control signal. (F.S.)

9621 IRRADIATION PROCESS AND APPARATUS. (to Saint-Gobain Techniques Nouvelles). British Patent 1,140,255. Jan. 15, 1969. Priority date Apr. 21, 1965, France.

A system is described for transferring an object such as a

radiation source, an article to be irradiated or an article which has been irradiated between the exterior and interior of a protectively shielded irradiation chamber. The object is introduced through an opening in the protective shielding into a cavity in a rotatable drum. The drum is rotated until the cavity is opposite the irradiation chamber so that the object can pass into the chamber. This allows irradiations to be applied to small quantities of substances or articles in rooms not especially equipped for working with radioactivity or for handling large and heavy equipment. (F.S.)

9622 AUTOMATIC SUPERCONDUCTING PUMP. Laquer, Henry L.; Carroll, Keith J.; Hammel, Edward F. (to United States Atomic Energy Commission). U. S. Patent 3,414,777. Dec. 3, 1968.

A superconducting magnetic flux pump circuit is described wherein a large hard superconducting inductance is connected in series with a small soft superconducting inductance and in parallel with a transformer and means connected to the primary winding of the transformer to induce an asymmetrical secondary waveform having a negative amplitude less than the positive amplitude, thereby causing rectification to occur automatically. (AEC)

9623 LOCAL STRESSES IN SUPPORT-SKIRT OF REACTOR PRESSURE VESSEL DUE TO AXISYMMETRIC LOAD. 1. Iwasaki, Tsutomu; Shimizu, Tasuku (Hitachi Ltd., Tokyo). Hitachi Hyoron, 50: No. 7, 1-5(July 1968). (In Japanese).

Local stresses in the support structure of a reactor pressure vessel due to axisymmetric loads were determined experimentally and theoretically. Depending on the radius of fillets, considerable local stress concentration was observed at the joint of support structure and pressure vessel. The experimental theoretical values agree well. The theoretical method is presented and found to be applicable for determining the axisymmetric load. For the welding shape at the joint of structure and vessel, it is preferable for the length of weld and fillet radius to be large. (NSA of Japan)

9624 LEAF SPRING-MOUNTED SHUTTER DEVICE ACTIVATED BY THE INTERRUPTION OF ELECTRICAL POWER. Hudgens, Claude R. (to United States Atomic Energy Commission). U. S. Patent 3,418,475. Dec. 24, 1968.

An x-ray safety device is described in which a shutter secured to a leaf spring is maintained out of alignment with an x-ray source under electrical energization conditions, but upon interruption of electrical power assumes a position overlying the x-ray source. (auth)

9625 IRRADIATION DEVICE. Makino, Sumio (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1968-20237. Aug. 30, 1968. Filed May 7, 1965.

A device by which radiation sources can be positioned close to the materials for irradiation, and the dosage distribution adjusted without a special accessory is described. The device consists of an irradiation vessel with irradiation openings; a container for radiation sources enclosed in the vessel with a plurality of penetrations towards the openings; a plurality of radiation sources contained in the respective penetrations; driving rods with one end flexible that support the sources so that the sources can move along the penetrations; a plurality of flexible tubes, one end of which connects to the penetration and the other end is positioned at the opening; a device for moving the "opening-side" end of the flexible tubes; a device for opening or closing the penetrations; and a device for determining the radiation fields for irradiation of materials. (NSA of Japan)

9626 METHOD FOR HOLDING AN IRRADIATION SAMPLE. Taniguchi, Kaoru (to Hitachi Ltd.). Japanese Patent 1968-20238. Aug. 30, 1968. Filed May 10, 1965.

A device by which a sample that gives off heat upon in-pile neutron irradiation can be held in a nuclear reactor in a safe manner is described. The support for a sample material (or a member to connect the two) is made of a material which fails at a temperature lower than that for the sample material. When the sample or the position of its support is heated excessively, the sample is dropped into a space where it is cooled, by means of the failure of the support material. (NSA of Japan)

9627 IRRADIATION DEVICE USING AN INERT GAS WITH A RADIOISOTOPE. Kasamatsu, Tomomichi (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-20236. Aug. 30, 1968. Filed Feb. 2, 1965.

An irradiation apparatus is described which permits the usage of high radiation energy due to the direct contact with a gaseous radiation source and high uniformity in radiation dosage due to a bubble contact. The apparatus consists of a reservoir for an inert-gas radiation source; a vessel for irradiation; tubing to connect the two; a device for circulating a gas through the reservoir and vessel; a device for drawing radioactive gas out of the vessel; a device for bubbling the gas through the liquid to be irradiated in the vessel; and a device for introducing into and withdrawing the liquid from the vessel. (NSA of Japan)

9628 TRAMEX WASHER AGITATOR (Engineering Materials). (Savannah River Operations Office (AEC), Aiken, S. C.). (CAPE-1811).

3 drawings.

An agitator for use in solvent washing in the Tramex Process to permit solvent reuse is described. The spent solvent and the wash solution are fed to the bottom of the axial mixing compartment. The mixed dispersion flows over the circular weir at the top of the mixing chamber, down through 4 channels, and into the annular setting section. Volume ratio of the separated organic and aqueous phases is controlled by adjusting the height of the aqueous overflow weir. In this way, the residence time is adjusted for the organic phase. (For details see TID-4100 Suppl. 49). (F.S.)

9629 SPECIFICATION FOR AIRBORNE CLOUD RADAR SYSTEM (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1807).

10 drawings.

Specifications are given for an airborne EHF cloud radar system developed to detect and delineate nuclear clouds so that an aircraft may be directed into the proper position to launch ballistic sampling rockets into the clouds. The system displays the horizontal contour of the near side of a cloud on a Plan Position Indicator showing the azimuth and slant range. The vertical contour of the near side of the cloud is displayed on a Range Height Indicator showing the elevation and the horizontal range. The system which operates in the Ka band (34.5 to 35.2 GHz) consists of radome and operator's control and display assemblies. The system is suitable for studies of cloud physics phenomena or other applications in which superior resolution, small antenna apertures, and reduced weight are considerations. (For details see TID 4100, Suppl. 49). (See also 21: 24135). (F.S.)

9630 NEUTRON IRRADIATION DEVICE. Suematsu, Shigeru (to Hitachi Ltd.). Japanese Patent 1968-22795. Sept. 25, 1968. Filed Dec. 15, 1965.

A neutron irradiation device is described in which a sample may be uniformly irradiated. The device consists of a circular target placed at the end of an accelerating tube; a pneumatic tube terminating at the position of the target; a circular sample holder placed within the pneumatic tube in parallel with the target; and two pipes running to the irradiation part of the pneumatic tube in a tangential direction. By introducing compressed air into the irradiation space through one pipe and withdrawing it through the other, the circular sample holder is rotated. (NSA of Japan)

9631 DEVICE FOR DETECTING THE POSITION OF A CONTROL ROD IN A SEALED VESSEL. Abe, Yasuhiro (to Mitsubishi Electric Corp.). Japanese Patent 1968-21273. Sept. 6, 1968. Filed Feb. 28, 1966.

A device for detecting the position of a control rod in a sealed vessel is described. The advantages of the device are low cost due to its compact construction and high accuracy in detection. The device consists of a pressure vessel containing a control rod shaft with a lid to the vessel and a downward double-walled protrusion. The bottom end of the double wall is closed so as to give a central axial hole. The space between the walls leads to the atmosphere. Springs located in the vessel supply pressure to the driving shaft. A rod of magnetic material is connected to the shaft end and extends into the central hole. Coils in the double-wall space detect the position of a control rod by means of the magnetic rod. (NSA of Japan)

9632 NEUTRON IRRADIATION DEVICE. Suematsu, Shigeru (to Hitachi Ltd.). Japanese Patent 1968-22794. Sept. 25, 1968. Filed Dec. 15, 1965.

A neutron irradiation device is described in which a sample may be uniformly irradiated. The device consists of a neutron-producing plate target placed at the end of an accelerating tube; a circular irradiation space positioned in a pneumatic tube parallel with the plate target; pipes connecting tangentially to the irradiation space which introduces compressed air into the space to rotate a sample; and a device for indicating the sample rotation. (NSA of Japan)

9633 DEVICE FOR EXPERIMENTING WITH A CAPSULE BY THE USE OF BELLOWS TO CONTROL THE IRRADIATION CONDITIONS. Hayashi, Takao (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-20239. Aug. 30, 1968. Filed Sept. 8, 1965.

A device is described that permits the in-pile irradiation conditions such as dosage and temperature to be controlled easily and positively by remote operation. The device consists of an inner

cylinder that contains the capsule; an outer cylinder to enclose the inner one; bearings at both ends of the inner cylinder; a rotating member with a spiral groove cut on the surface connected to one end of the inner cylinder; a bellows positioned next to the rotating member which has a claw that engages with the groove; an outer cylinder to contain the rotating member, the corresponding bearing, and bellows; and a gas tube connected to the bellows which supplies the bellows with a gas pressure. In order to rotate or move axially the inner cylinder, the desired gas pressure is applied within the bellows or it is released; the latter action either expands or contracts the bellows that activate the claw. (NSA of Japan)

9634 IRRADIATION DEVICE. Nakai, Yasushi (to Mitsubishi Atomic Power Industries, Ltd.). Japanese Patent 1968-20231. Aug. 30, 1968. Filed Feb. 1, 1966.

Usually a sample material in a capsule is irradiated in an irradiation hole of a nuclear reactor, with lead wires being connected to the capsule. A method is described that will permit these lead wires to be disconnected easily and without destroying air-tightness when irradiation has been finished. The irradiation device consists of a handling rod which inserts into and withdraws a capsule from the irradiation hole; a plug connecting the handling rod and the capsule which introduces the lead wires from within the rod to the measuring elements within the capsule; and a member protruding from the upper surface of the irradiation hole which disconnects the capsule by engaging it and dropping it into a hole branching from the irradiation hole. (NSA of Japan)

9635 MANIPULATOR WITH A HOIST. Hagiwara, Satoru (to Mitsubishi Electric Corp.). Japanese Patent 1968-21279. Sept. 6, 1968. Filed Dec. 2, 1965.

The design of a manipulator with a hoist used for remotely handling radioactive materials consists of a truck running along a guide rail, a second set of guide rails which is part of the truck frame and perpendicular to the first rails, a manipulator running along the second set of rails and suspended from them, and the hoist running along the same rails near and in parallel with the hoist and suspended from them. (NSA of Japan)

9636 VELOCITY GAGE (Engineering Materials). (Sandia Lab., Albuquerque, N. Mex.). (CAPE-1803). 37 drawings.

An extended range velocity gage for measurements in high shock environments is described. The gage is a highly overdamped low-natural-frequency accelerometer operating in the "velocity" portion of its response spectrum. The gage covers the frequency response range from 0.01 to 600 cps, measures velocity from 0.0 to 600 ft/sec and withstands 3000 g shock. The gage is capable of making ground motion measurement near subsurface nuclear and chemical explosions and in shock tubes. (For details see TID-4100 Suppl. 49) (see also 19: 38864) (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 9609, 9610 and 9613.

9637 (D-1-82-765) STABILITY OF PLANE BLAST WAVES. Gerwin, Richard; Hall, Richard B. (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Oct. 1968. 58p.

The stability of a plane blast wave to surface perturbations is examined. It is found possible by making a "thin" sheet approximation to the geometry, to obtain a set of ordinary differential equations which describe the sheet motion. These equations are effectively solved for all possible initial conditions. It is found that surface perturbations grow rapidly at first but are eventually limited in amplitude. All perturbations grow in amplitude like powers of time. (auth)

9638 (DSR-79760-59) REFRIGERANT FORCED-CONVECTION CONDENSATION INSIDE HORIZONTAL TUBES. Bae, Soonhoon; Maulbetsch, John S.; Rohsenow, Warren M. (Massachusetts Inst. of Tech., Cambridge. Heat Transfer Lab.). Nov. 1, 1968. Contract ASHRAE-RP63. 80p. Dep.

Condensing heat transfer rates inside a horizontal tube were investigated for large quality changes across the tube. The proposed correlation is a modification of the work of Rohsenow, Webber and Ling. The results of the investigation are modified through new variables which include the effect of the true axial pressure gradient in a tube. Experimental data are presented for a range of flow conditions. A 0.493 in. ID, 19.75 ft. long nickel tube was used for condensing Refrigerant-12. The saturation temperature was varied from 84.6°F to 118°F and flow rates of vapor-liquid mixture ranged from 151,000 lbm/ft²hr to 555,000 lbm/ft²hr. The inlet quality was essentially 100% at saturation and exit qualities ranged from 50% to zero and subcooled liquid. The test results for average heat transfer coefficient were correlated by the analysis within 15%. (auth)

9639 (IN-1263) EX-REACTOR HEAT TRANSFER EXPERIMENTS SIMULATING ETR FUEL ELEMENT GEOMETRY. Griebenow, M. L. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Dec. 28, 1964. Contract AT(10-1)-205. 20p. Dep. CFSTI.

ETR conditions were simulated in an ac resistance-heated, ex-reactor test section. All convective heat transfer data fell within ±20% of the Modified Colburn Equation indicating this equation with a 20% safety factor is adequate. However, the Dittus-Boelter Equation had a ±15% accuracy and followed the data trend much better in the high heat flux range ($1\text{-}2 \times 10^6$ Btu/hr,ft²). For this reason and since it eliminates the need for frequent trial and error solutions, the adoption of the Dittus-Boelter Equation with a 15% safety factor is recommended. The Jens and Lottes Correlation fits all fully developed nucleate boiling data to within ±12°F. Burnout occurred at 85% of the value predicted by the improved Bernath Correlation justifying the continued use of the equation with a 40% safety factor. It was found that the convective heat transfer from the corners and the short walls (simulated side plates) correlated well with the Dittus-Boelter Equation, assuming the velocity was reduced 43%. (auth)

9640 (IN-1267) PROPOSED HEAT TRANSFER EXPERIMENTS WITH DIRECT APPLICATION TO TESTING REACTORS. Francis, W. C.; Griebenow, M. L. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 25, 1960. Contract AT(10-1)-205. 39p. Dep. CFSTI.

An experimental program designed to obtain engineering information directly applicable to the cooling of testing reactors using sub-cooled water is described. The purpose of the study is to increase the heat removal efficiency in testing reactors, to evaluate new fuel element designs capable of operating at higher power densities, to determine through kinetic studies the effect of hydraulic and/or power transients, and to develop correlations for specific channels, describing the different modes of heat transfer. The nucleate boiling mechanism will be emphasized in order to achieve the higher heat transfer rates inherent in this mode of cooling. To insure safe operation, it is necessary to evaluate the extent of possible flow redistribution, the burnout point, the entrance to film-boiling and the possibility of physical meltdown. The proposed experiments will be conducted in an existing 200 kW electrically heated loop designed to simulate a constant pressure drop system. A small re-entrant loop will be inserted in a reactivity measurement facility to determine the effect of nucleate boiling on reactivity. If the results of the out-of-pile work are favorable, preliminary in-pile tests in the nucleate boiling region will be conducted using a specially loaded (highly fueled) test element. The direct result of all of these tests will be to determine quantitatively the benefits, feasibility and margin of safety in operating test reactors in nucleate boiling. If these data indicate that this mode of reactor operation is attractive and practical, consideration will be given to the performance of such a test using one of the test reactors. Results obtained should allow an increase in the power density (and an associated increase in neutron flux), a reduction in operating pressure, and/or a reduction in the coolant flow rate. Investigations are included to prove that existing safety factors (required as a result of the hot spot-hot channel analysis) can be reduced without undue hazard to the reactors. This should allow less restrictive fuel loading, reduced manufacturing tolerances on the fuel elements and reduced production costs. This phase of the program should allow reduced operating restrictions on the reactors and on the experiments thus saving time and money spent in "safe-guarding." (R.C.K.)

9641 (KAPL-M-6926) DEVELOPMENT OF THE ROVER COMPUTER PROGRAM FOR FLOW-INDUCED, SELF-EXCITED VIBRATION OF A BLADE IN A FLOW CHANNEL. Kennison, R. G. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 26, 1968. Contract W-31-109-eng-52. 61p. Dep. CFSTI.

The status of the ROVER computer program for flow-induced, self-excited vibration of a blade which is elastically suspended in a flow channel is described. This program includes crossflow around the blade edges in addition to longitudinal flow past the blade. A brief description is given of the operation of the current program and interpretation of the computer output. The analyses and equations for the blade stability conditions used in the program are also presented. (auth)

9642 (UCRL-50510) CONCEPT FOR A GAS BUFFERED ANNULAR HEATPIPE FUEL IRRADIATION CAPSULE. Lee, J. D.; Werner, R. W. (California Univ., Livermore. Lawrence Radiation Lab.). July 25, 1968. Contract W-7405-eng-48. 25p. Dep. CFSTI.

A nuclear fuel irradiation capsule capable of handling large

($\approx$300 W/cm^2) and varying fuel specimen heat fluxes while inherently maintaining nearly constant specimen temperature was conceived and two bench models successfully tested using potassium and sodium as the working fluids. Test temperatures were in the 700°C range and heat source temperatures were preserved within ±15°C while undergoing factors of three changes in power. (auth)

9643 EFFECTS OF GAMMA RADIATION ON BUBBLE NUCLEATION AND NUCLEATE POOL BOILING HEAT TRANSFER. Harrison, Dwight Harwood. University Park, Pa., Pennsylvania State Univ., 1968. 216p.
Thesis.

The general question of heat transfer changes by gamma radiation was considered. Two basic aspects were investigated theoretically and experimentally: first, the minimum liquid superheat for gamma radiation to nucleate bubbles, and second, the effects of radioinduced bubble nucleation on heat transfer. A group of parameters was derived to characterize the limit of superheating with gamma radiation present. This parameter group was essentially a ratio of the minimum energy to form a bubble nucleus to the path length across the region of liquid which was vaporized to form the nucleus. The value of this group was a function of the liquid pressure and superheat. Experiments were conducted in which the limit of superheating with and without cobalt-60 gamma radiation present was observed in Freon-12 and Freon-114. In these experiments droplets of Freon were injected into water and the pressure of the system lowered. The minimum pressure for the presence of liquid Freon was observed. These experiments showed that a constant value of the parameter group satisfactorily defined the minimum amount of superheating at which radioinduced nucleation would occur. By considering theoretically the heat transfer processes, particularly boiling, it was concluded that radiation-nucleated bubbles would have the greatest probability of changing those heat transfer processes which were controlled by bubble nucleation. On this basis it was further concluded that the inception of nucleate boiling, where a large initial surface superheat was required for initiation, was the most likely condition to be affected by gamma induced bubble nucleation. Experiments were conducted on the heat transfer from a 0.004 inch diameter platinum wire to a stagnant pool of Freon-12 in one case and Freon-114 in the other. The pool was contained in a pressure vessel and operated at pressures up to about three-fourths of critical. A cobalt-60 gamma source could be remotely positioned adjacent to the pool. Observations of the heat transfer were made under conditions which were identical, except for the presence of the gamma source. It was demonstrated that under certain conditions gamma radiation could reduce the surface superheat at the inception of nucleate boiling or, conversely, exposure to the source could start nucleate boiling. The experiments showed no effect of the gamma radiation on steady nucleate boiling or the transition from nucleate to film boiling. (Disser. Abstr.)

9644 HEAT PIPES. Fiebelmann, Peter (to EURATOM). U. S. Patent 3,414,475. Dec. 3, 1968. Priority date May 20, 1965, Germany.

A tubular heat pipe comprising an evaporization zone, with an internally mounted fissile heat source, and a condensation zone, with external secondary cooling means is described. The pipe is at least partially filled with a liquid coolant which evaporates in the evaporization zone and returns, after condensing, along the inner surface of the pipe walls to the evaporization zone. A circular gap is formed between the tube wall and the heat source with a capillary inlet. (Offic. Gaz.)

9645 EXPERIMENTAL STUDY OF VIBRATION OF FLEXIBLE CYLINDERS INDUCED BY NOMINALLY AXIAL FLOW. Paidoussis, M. P. (McGill Univ., Montreal). Nucl. Sci. Eng., 35: 127-38(Jan. 1969).

Three types of experiments were conducted in a study of flow-induced vibration of cylinders: experiments with a single cylinder in the test section, in which the length, mass, flexural rigidity, and diameter of the cylinder, and the flow velocity were varied systematically, in order to obtain a measure of the dependence of vibration amplitude on these parameters; ad hoc experiments with single cylinders on the effect of large-scale flow disturbances upstream of the cylinder; and experiments with a bundle of cylinders. A previously derived empirical expression for predicting vibration amplitude was revised, and agreement with the experimental data from various sources was improved; however, agreement with the experiments with a bundle of cylinders remains poor. (auth)

9646 THERMAL EQUILIBRIUM OF A VAPOUR BUBBLE ON A HEATED SOLID SURFACE. Gaddis, E. S. Manchester, Eng., Univ. of Manchester, 1968.
Thesis.

Theoretical solutions are advanced which predict the vapor temperature inside a vapor bubble in thermal equilibrium on a heated solid surface. A model is presented, based on conduction as the dominant mechanism in the liquid and on vapor transfer within the bubble. No artificial restrictions are made at the bubble surface, and the only condition to be fulfilled by the mathematical solution is continuity of heat flux and temperature at the liquid-vapor, liquid-solid and vapor-solid interfaces. The model shows that considerable temperature differences between the liquid-vapor interface and the vapor exist near the bubble base. In the absence of a forced flow two factors may induce convection in the liquid surrounding the bubble. The first arises from evaporation and condensation at the liquid-vapor interface, and the second from variations of surface tension over this interface. These two factors were investigated. It was found that liquid motion due to phase change has an insignificant effect on the thermal equilibrium of the bubble, but surface circulation caused by thermocapillarity may be important. An experimental investigation tested the different nucleation theories. It was found that the vapor temperature inside the bubble, when the cavity is just critical, cannot be explained either by pure conduction or by pure convection due to forced flow. The experimental results approach the predicted results at high wall heat fluxes and large cavity sizes when liquid motion due to surface circulation is taken into account. At low wall heat fluxes and small cavities there is a discrepancy between experimental and theoretical results; experimental results gave lower vapor temperatures than predicted. A possible reason for the experimental behavior at low wall heat fluxes and small cavity sizes is the presence of impurities in the fluid; such impurities may result in the formation of surface films and may affect the mechanism of phase change at the interface. Further work is required to investigate these effects. (auth)

Isotope Technology

Refer also to abstracts 9543, 9556, 9573, 9669, 9675, and 9764.

9647 (EUR-4056) DETECTION OF GAS LEAKS BY MEANS OF RADIOACTIVE TRACERS. PART 1 AND 2. Bruna, A.; Caldera, P. G.; Agelao, G.; Benincasa, G. (Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari). Mar. 7, 1968. Contract 092-65-10 IRAI. 36p. (In French). Dep.

A critical and comparative study was made of methods of detecting leaks in underground gas mains using methyl bromide labeled with ^{82}Br and a sodium chloride aerosol labeled with ^{24}Na. This study was based on tests of the first method and preliminary data on the second. A description is given of research undertaken to improve the method of detecting leaks by means of a sodium chloride aerosol. (auth)

9648 (GAT-Z-5045) SOME TECHNOLOGICAL AND EXPERIMENTAL PROBLEMS INVOLVED IN THE CONSTRUCTION OF THE PIERRELATTE GASEOUS DIFFUSION UNIT. Translated by J. M. Woods (Goodyear Atomic Corp., Piketon, Ohio), from Energ. Nucl. (Paris), 9: 489-95(1967). 10p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 23231. (R.C.K.)

9649 (LA-DC-10021) PRODUCTION OF ^{252}Cf IN THERMONUCLEAR EXPLOSIONS. Cowan, George A. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 6p. (CONF-681032-1). Dep. CFSTI.

From Symposium on Californium-252, American Nuclear Society, New York.

The high-flux reactor and large thermonuclear explosions are compared for the production of ^{252}Cf. The target material in both cases is ^{238}U. In the explosion, 5g of ^{252}Cf can be produced at $2,000,000 per gram. Other valuable products would also be made in the explosion. For example, the device would synthesize 20 mgs of ^{257}Fm which is about 10^7 times more than may be produced in high-flux reactors. The explosion would also produce about 10g of ^{250}Cm. The device itself is capable of producing elements of mass 272 and higher in sufficient quantity to identify them and to characterize the chemical behavior of new, undiscovered elements if any of these isotopes lives more than a few hours. (F.S.)

9650 (MLM-1556) RADIATION MEASUREMENTS OF ^{238}Pu ENDOGENOUS HEAT STUDY SOURCES FOR THE ARTIFICIAL HEART PROGRAM. Anderson, M. E.; Neff, R. A.; Campbell, A. R.; Hagee, G. R. (Mound Lab., Miamisburg, Ohio). Dec. 27, 1968. Contract AT(33-1)-Gen-53. 24p. Dep. CFSTI.

Detailed radiation measurements were performed on 16-W and 24-W encapsulated plutonium-238 heat sources for use in endogenous heat studies as part of the Artificial Heart Program. The neutron energy spectra, neutron emission rates, gamma energy

spectra and gamma dose rates were measured, and the neutron dose rates were calculated. In general, the results did not deviate significantly from results obtained previously from many other encapsulated plutonium-238 heat sources in which the plutonium is present as the metal. (auth)

9651 (ORNL-IIC-17) LIST OF AEC RADIOISOTOPE CUSTOMERS WITH SUMMARY OF RADIOISOTOPE SHIPMENTS, FY 1968. Curl, Ruth (comp.) (Oak Ridge National Lab., Tenn.). Dec. 1968. Contract W-7405-eng-26. 32p. Dep. CFSTI.

The fifth edition of the AEC radioisotope customer list is presented. The information is divided into four sections. The first is an alphabetic list of customers, subdivided into domestic and foreign categories with the source of supply designated. The second is an alphabetic list of the isotopes, cross-referenced to customer numbers again subdivided into domestic and foreign categories. The third list gives the alphabetized geographic locations of the isotope users. The fourth listing is a comprehensive table which includes an alphabetic listing of the isotopes and a breakdown into shipments, quantities, and dollar value for each isotope under the domestic, foreign, and AEC facilities categories, including the total figures for each isotope. (L.C.L.)

9652 (ORNL-TM-2223(Pt.3)) SELECTED ABSTRACTS OF NON-U. S. LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES (FROM NSA JULY-SEPTEMBER 1968). Gerrard, Martha; Baker, P. S. (Oak Ridge National Lab., Tenn.). Jan. 1969. Contract W-7405-eng-26. 39p. Dep. CFSTI.

Approximately 360 abstracts of non-U.S. publications on production and use of radioisotopes and radiation, selected from the July-September 1968 issues of Nuclear Science Abstracts, are presented. (auth)

9653 (SC-RR-68-832) RADON PRODUCTION IN $^{238}PuO_2$ FUELS. Parsont, M. A. (Sandia Labs., Albuquerque, N. Mex.). Dec. 1968. 16p. Dep. CFSTI.

The production of radon species from Pu isotopes and impurities in $^{238}PuO_2$ fuel material has caused some concern from the health physics standpoint. The potential biological effect on a human was shown to be small based on comparison to current MPC values. Calculations showed that pressure from radon species would not exceed 10^{-7} atmospheres in SNAP-19 capsules in the range of operating temperatures. Data are presented which allow the simple computation of pressure and activity from radon produced in $^{238}PuO_2$ fuel having certain impurities. These data can be used for any system using $^{238}PuO_2$ fuel material. (auth)

9654 (TID-24699) APPLICATION OF THE RADIOISOTOPE-FUELED STIRLING ENGINE TO CIRCULATORY SUPPORT SYSTEMS. Final Report. Goranson, R. B. (McDonnell Douglas Corp., Richland, Wash.). June 1968. Contract AT(45-1)-2112. 229p. Dep. CFSTI.

A design and analysis study to develop a conceptual design of a radioisotope-powered thermodynamic engine to serve as the power source in an implantable circulatory support system is presented. The study establishes the technical feasibility of a Stirling cycle engine using radioisotope fuel. Thermodynamic operating principles are given, and design and operating details of the power source are described. Shielding requirements and radiation level at the power source surfaces are presented parametrically. (auth)

9655 (WAI-TR-68.2) A COLLATION AND EVALUATION OF ANALYSES AND EXPERIMENTS ON THE RE-ENTRY BEHAVIOR OF PuO_2 MICROSPHERES. Pyatt, David W.; Ostrowski, Peter P. (Weiner Associates, Inc., Baltimore, Md.). Aug. 1968. Contract AT(29-2)-2518. 114p. Dep. CFSTI.

Analytical and experimental information generated by the AEC and its contractors on the reentry performance of PuO_2 microspheres is presented. Analyses and experiments on the reentry of PuO_2 microspheres were documented. A state-of-the-art survey was established. It was found that the theories for the prediction of breakup or instability for both fully and semi-molten microspheres are too approximate to be used. The most useful data for correlating breakup are shock tunnel experiments on zirconium and Fe_2O_3 particles and, to a lesser extent, arc tunnel experiments on $^{238}PuO_2$ in microspheres. The experimental results cannot be directly applied to real atmospheric release conditions. Melting initiation can be predicted in release coordinates. Once melting begins, the fluid dynamic behavior of the molten PuO_2 and its effects on the heat transfer is not known. Significant deformation results from deceleration forces. The only experiments where deceleration forces were included are the shock tunnel experiments. Based on the arc tunnel experiments, two criteria for mass loss were observed: non-breakup mass loss attributed to vaporization, boiling of impurities or trapped helium blowout and breakup and/or stripping. The first mechanism results in particles ranging in size from molecular diameter to approximately 1 μm. The second mass loss mechanism results in particles from submicron to greater than 10 microns in diameter. (auth)

9656 METHOD FOR SEPARATING ISOTOPES. Kakihana, Hidetake; Seko, Maomi (to Asahi Kasei Kogyo Kabushiki Kaisha). U. S. Patent 3,414,500. Dec. 3, 1968. Priority date Aug. 2, 1963, Japan.

A method of obtaining isotopes in the ion state with an electrodialysis apparatus is described. A plurality of cation permselective membranes and anion permselective membranes are alternately arranged between an anode and a cathode. An electrolyte solution containing isotopes to be separated in the ion state is fed into a compartment which is constituted by the cation permselective membrane on the cathode side and the anion permselective membrane on the anode side. A direct electric current is passed through the apparatus. The isotopic ions to be separated migrate selectively through membranes of the same charge into the adjacent compartments. The solution is refluxed from the compartment successively into every other compartment in a direction opposite that of the isotope electromigration. Lighter isotope ions are found in the compartment near the electrode. The direction of electromigration and heavier isotopes is found in the compartment near the electrode in a direction opposite to that of the electromigration. (Offic. Gaz.)

9657 LOW ENERGY ISOTOPES FOR INDUSTRIAL RADIOGRAPHY. Chrimes, N. W. D. (Australian Atomic Energy Commission, Canberra). At. Energy Aust., 11: No. 4, 13-17 (Oct. 1968).

The radioisotopes ^{241}Am, ^{153}Gd, ^{145}Sm, ^{153}Sm, ^{170}Tm, and ^{133}Xe were evaluated for use in radiography of thin sections of less dense materials such as Al and Mg. Thulium-170 is considered to provide the best combination of photon energy, specific activity and half-life. A maximum activity of about 50 Ci can be expected from 4 × 4 mm sources irradiated in the HIFAR reactor and sources of this nature provide a convenient and cheap source of low energy gamma radiation for the radiography of thin sections and/or light materials. (F.S.)

9658 THIN SOURCES OF ^{234}Th AND ^{234}Pa FOR β SPECTROMETRY. Godart, J.; Gros, H.; Gizon, A. (Centre d'Etudes Nucleaires, Grenoble, France). Radiochim. Acta, 10: 101-3 (1968). (In French).

With a solution adjusted at 0.5 M uranyl nitrate and 0.5 N HNO_3, ^{234}Th was separated from ^{238}U on Dowex 50 W X 8. After extraction of the ^{234}Th by oxalic acid, purification and separation of the daughter isotopes ^{234m}Pa ($T_{\frac{1}{2}}$ = 1.17 min) and ^{234}Pa ($T_{\frac{1}{2}}$ = 6.7 h) were obtained on Dowex 1 X 8. Thin and uniform samples of UX 1 and UZ were prepared by evaporation in vacuum for β^- counting at low energies. (auth)

9659 USE OF RADIOACTIVE ISOTOPES IN THE PULP AND PAPER INDUSTRY. Malachowska, N. (Pulp and Paper Research Inst., Lodz, Poland). PTJ Dodatek, No. 42(315), 66p.(1967). (In Polish).

Problems concerning the use of radioactive isotopes are discussed. The main field where these isotopes may be used is in measuring techniques in the paper industry. The measurement of substance and moisture content, measurement of substance combined with control of the paper machine and measurement of the liquid level are discussed. Principles of radiometric instrument operation, the kinds of instruments used and the characteristics of their performance are presented. Radioactive isotopes are also used for analyses when the properties of wood, cellulose and waste liquor are being investigated. The use of radioactive tracers, especially for investigations of the development of technological processes are summarized. Ionizing radiation may be also used for removal of static electricity, removal of mold, for processing of coated papers, measurement of the thickness of roll walls and of the quantity of condensate in the drying cylinders. (NSA of Poland)

9660 IMPROVEMENTS IN OR RELATING TO RADIOISOTOPE-POWERED THERMOELECTRIC GENERATORS. Yeats, Francis William; Stevenson, Jeremy (to United Kingdom Atomic Energy Authority). British Patent 1,137,866. Dec. 27, 1968. Filed Apr. 8, 1965.

A radioisotope-powered thermoelectric generator is described having a radioactive isotope heat source, a thermoelectric module in thermal contact with the heat source, and a shield which surrounds the heat source and absorbs the radioactivity. The shielding includes a removable plug to which the thermoelectric module is secured. The plug enables the module to be removed from the generator for replacement or inspection, leaving the greater part of the shield intact with the radioisotope heat source inside. The plug is stepped so that the radiation cannot "shine" past it. The heat source is surrounded by thermally-insulating material, e.g.,

a fibrous microcellular material. The contacting surfaces of the thermoelectric module and the heat source are lapped flat, and means are provided to urge the surfaces into contact and further means enable the heat source to rock slightly to take up the best contact position. A thin layer of electrically insulating alumina is interposed between the thermoelectric module and the heat source and between the module and the plug to which the module is secured. (UK)

9661 IMPROVEMENTS IN AND RELATING TO LIGHT SOURCES. Linhart, Theo Frank; Doda, Robert John; Mahon, Arthur Francis (to American Atomics Corp.). British Patent 1,139,829. Jan. 15, 1969. Priority date July 8, 1965, United States.

An improved self-luminous light source using a phosphor excited by radioactive material is described. The source consists of a cerium-bearing tubular glass envelope which encloses an Al metallic core with an inorganic phosphor such as zinc sulfide applied to the core surface, and a radioactive gas such as krypton-85 or tritium. The light source needs no maintenance and is useful for signal lanterns or warning devices. (F.S.)

9662 RADIONUCLIDE BATTERIES FOR ENERGY SUPPLY IN SPACE. Euler, J. (VARTA AG, Frankfurt am Main); Scharmann, A. Kerntechnik, 10: 599-607(Nov. 1968). (In German and English).

The principles and design of radionuclide batteries are discussed. The special requirements for use in space severely restrict the range of suitable radionuclides. Known data on radionuclide batteries designed or projected for use in space are presented. The energy content and possible power production are compared with those for electrochemical power sources. (auth)

Materials Testing

Refer also to abstracts 9544, 9582, 9587, 9589, 9657, 9676, and 11235.

9663 (BDX-613-107) NONDESTRUCTIVE TESTING OF PERCUSSIVE ARC WELDS. Estep, C. C.; Genser, D. S.; Stone, W. J. (Bendix Corp., Kansas City, Mo.). June 1967. Contract AT(29-1)-613. 11p. Dep. CFSTI.

An investigation, performed to determine feasibility of developing a means of nondestructive testing for percussive arc welded electrical connections, revealed trends which are of apparent value in further study and evaluation. Of five methods investigated, one offers good promise of accomplishing the objective after further refinement of the technique. The results obtained from the five separate tests conducted, and an account of the procedures used in the most successful method, are included. (auth)

9664 (BNWL-919, pp 7.1-12) NONDESTRUCTIVE TESTING. Dau, G. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Recent developments in eddy current, thermal, and ultrasonic methods of nondestructive materials testing are described. A clarification of the relationship between three impedance diagrams that employ different units and presentations, and which are commonly used in eddy current testing methods is included. Developments in thermal methods include adaptation of a 30 W carbon dioxide laser for use with a transient test system, and partial success in producing a high-frequency transducer for thermal-wave testing. Test data on ultrasonic properties scatter in irradiated Type 304 stainless steel are discussed. The problems of fabricating lithium sulfate transducers for metal thickness gages are described. Test data on the attenuation of ultrasonic pulses in aluminum, quartz, and steel are presented. (L.C.L.)

9665 (BNWL-942) EDDY CURRENT TEST PATTERN RECOGNITION PROGRAM. Ord, R. N.; Richardson, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1968. Contract AT(45-1)-1830. 43p. Dep. CFSTI.

The size and shape of a test pattern generated by an eddy current probe passing a flaw defect in metal tubing presents an opportunity to classify flaw patterns using automated techniques. The first step in this direction was the development of a mathematical model making use of the first two statistical moments to correlate an unknown pattern with a standard set of known patterns. Twelve of the 20 patterns selected at random were identified with the standard set of 23 patterns. The accumulation of experience with this process will lead to an improved set of standard patterns and consequent improvement in random pattern identification. The ultimate goal of this program will be the development of a test box for field use which will be used for eddy current incipient failure testing. (auth)

9666 (CEA-CONF-1069) USE OF ULTRASONICS FOR TESTING FOUNDRY BILLETS AND SEMI-FINISHED EXTRUSIONS IN ALLOYS OF THE Mg-Zr TYPE FOR CANNING. Destribats, M. T.; Lestiboudois, G.; Papezyk, F.; Richard, P.; Trieule, A. (Commissariat a l'Energie Atomique, [Saclay] (France). Centre d'Etudes Nucleaires); Bitran, M.; Huicq, R.; Laurent-Athalin, G.; Scheidecker, M.; Soulet, C. (Societe Trefimetaux, Argenteuil (France)). [nd]. 17p. (In French). (CONF-680606-8). Dep.

From Symposium on Nondestructive Testing and Control in the Field of Nuclear Metallurgy and Technology, Saclay, France.

Ultrasonic frequencies are suitable for examining the quality of parts with a magnesium base, and a method for testing the manufacturing quality of cans for fuel elements of the natural uranium/graphite/CO_2 system is examined. Inspection at the factory was carried out in the foundry on billets and then after extrusion on semi-finished products. Comparisons of the quality classifications at the two stages of inspection were made. An experiment was carried out on 24 billets of different qualities and 260 blanks produced from them were inspected. The influence of superficial defects on the quality classification of the blanks was studied. Conclusions were obtained about the practical value of the two types of inspection. (auth)

9667 AN IMPROVED FACILITY FOR TESTING SOILS IN ONE-DIMENSIONAL COMPRESSION. Schindler, L. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). pp 847-60 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

Several facilities have been developed in the past few years for the purpose of determining the one-dimensional-compression properties of soils under the high-amplitude, short-duration, impulsive loads characteristic of the air blast and ground shock from a nuclear explosion. These facilities are shown to be subject to certain limitations, which are directly related to the nature of the load-application system used. A newly developed test facility, which incorporates an improved method of load application, is described and analyzed. It is shown that this facility is characterized by greater versatility and better performance than was possible with the previously developed facilities. (auth)

9668 IMPROVEMENTS IN OR RELATING TO NON-DESTRUCTIVE TESTING OF CASTINGS. (to Hoesch Aktiengesellschaft). British Patent 1,131,218. Oct. 23, 1968. Priority date Mar. 29, 1965, Germany.

A radiometric method is described for the nondestructive location and examination of cavities in metallic castings. The geometrical position of the cavities is located by means of a radiation method as the castings move past units arranged one after the other in the direction of movement. Once a cavity is located, the speed of movement of the material is reduced as the detected cavity passes an activation analysis unit. After activation, the emanating radiation is detected by a scintillation counter. (B.L.M.)

9669 NEUTRON RADIOGRAPHY AND ITS APPLICATION. Accinni, F.; Tonolini, F. (Centro Informazioni Studi Esperienze, Milan). Energ. Nucl. (Milan), 16: 65-73(Jan. 1969). (In Italian).

A survey on neutron radiography and its practical applications is presented. Its complementarity with x or γ radiography, its capability to discriminate between close atomic weight elements and increasing availability of dependable, handy and cheap units make this radiographic method very attractive. (auth)

Protective Structures

Refer also to abstract 9605.

9670 (NVO-99-29) CONCRETE TEST STRUCTURES: FIRST PROGRESS REPORT ON STRUCTURAL RESPONSE. (Blume (John A.) and Associates Research Div., San Francisco, Calif.). Mar. 1968. Contract AT(26-1)-99. 126p. Dep. CFSTI.

The results of five series of field tests performed to determine the structural response characteristics of two identical four-story reinforced concrete test structures located in Area 1 of the Nevada Test Site are presented. Lateral motion of the structures in response to free vibration tests, forced vibration tests, and underground nuclear explosion generated ground motion were recorded by means of instruments located at various points on and near the structures. Natural periods of vibration and damping values were obtained from the records. Relationships between the

measured response characteristics and the measured lateral displacements are plotted and discussed. Comparisons between measured and theoretical values are made. The structures have exhibited pronounced increases in period and damping, following exposure to strong ground motion, although there is only slight visual evidence of damage. Temporary partitions caused moderate increases in stiffness and in damping. Period and damping both increased with increased lateral displacement during forced vibration testing. (auth)

9671 (ORNL-TM-2134) ROLE OF A BLAST SHELTER SYSTEM IN STRATEGIC DEFENSE. Uher, R. A. (Oak Ridge National Lab., Tenn.). Jan. 1969. Contract W-7405-eng-26. 163p. Dep. CFSTI.

Progress in a study examining the role of a blast shelter system in strategic defense is reported. Blast shelter systems which are not protected with ballistic missile defense are discussed. Assuming that the attacker launches an attack of many 10 megaton weapons targeted to destroy as many people as possible, blast shelter systems can be developed which will save large numbers of people against such attacks. Blast shelter systems protected by a light, area-type ballistic missile defense are evaluated. Two categories of blast shelter systems defended by area defense are discussed. The first system (referred to as non-optimum) has a single shelter type (one LD-50 overpressure, i.e., peak overpressure at which 50% of people are killed) and shelters people living in high population density areas. Systems in the second category (referred to as optimum) consist of shelters whose LD-50 overpressure varies continuously with population density. At any defense expenditure, the optimum systems are designed to produce minimum fatalities against an attack designed to produce maximum fatalities. All attacks consist of 300 kiloton weapons. The results show that non-optimum shelter systems save the most people when their LD-50 overpressure lies between 80 and 120 psi. Optimized attacks against non-optimum systems costing 10 billion dollars produce fatalities 10 to 15% higher than against corresponding optimum systems. At a 30 billion dollar defense expenditure, fatalities for non-optimum systems run 20 to 40% higher than optimum systems. Although optimum systems have a greater life-saving potential than non-optimum systems, it is concluded that it may not be economically feasible to keep these systems optimum over long periods of time. Changing defense concepts, offense motives and population density contribute to the problem. (auth)

9672 BLAST-INDUCED BODY MOTIONS OF BURIED STRUCTURES WITH FOOTINGS. Allgood, J. R. (Naval Civil Engineering Lab., Port Hueneme, Calif.); Carter, W. O. pp 315-33 of Proceedings of International Symposium on Wave Propagation and Dynamic Properties of Earth Materials held on August 23-25, 1967 at Albuquerque, New Mexico. Triandafilidis, George E. (ed.). Albuquerque, N. Mex., University of New Mexico Press, 1968.

See CONF-670804.

An approximate theory is presented for predicting the relative body deflections of a shallow-buried shelter. The theory consists of two coupled parts, one that describes the motion of the free field and another that defines the motion of a model of the structure including its foundation and covering soil. The equations of motion are solved with the aid of a digital computer, and the results are compared with available test data. The theory permits selection of a footing width that will limit to a predefined value the relative deflection between the footing and the floor slab. (auth)

9673 IMPROVEMENTS IN AND RELATING TO BUILDING COMPONENTS. Donath, Alfred; Hofflinghaff, Wilhelm; Kocemba-Wysocki, Waldemar (to Glasswall Projects Ltd.). British Patent 1,137,554. Dec. 27, 1968. Filed Sept. 20, 1965.

A method is described of making a building component for protection from electromagnetic radiation wherein a paste or powder formed of a compound containing lead mixed with an animal or vegetable oil or with an epoxy resin to serve as a filler and/or binder is moulded under pressure, and heated before, during or after the moulding operation. Preferably lead monoxide (PbO) in powder form is employed, but one or more other lead oxides may be used. A preferred oil is linseed oil. (UK)

9674 FALLOUT AND WEAPONS RADIATION SHIELDING. Chilton, A. B. (Univ. of Illinois, Urbana). Nucl. News, 12: No. 2, 49-51(Feb. 1969).

The fundamentals of fallout shielding to protect populations from the effects of nuclear explosions are reviewed briefly. Office of Civilian Defense standards and the categories of professional people working in this field are mentioned. (L.C.L.)

9675 CELLS AND EQUIPMENT FOR THE ISOLATION OF NUCLIDES OF HIGH SPECIFIC ALPHA ACTIVITY. Hoehlein, G.; Weinlaender, W. (Technische Hochschule, Munich). Kerntechnik, 10: 639-42(Nov. 1968). (In German and English).

The overall design and ventilation system of a facility for the isolation of nuclides of high specific alpha activity in the multicurie range are described. The irradiation technique, the apparatus for cutting up capsule jackets, and the chromatography of nuclides of high alpha activity are also discussed. (auth)

Radioactive Material Handling

Refer also to abstracts 9621 and 11393.

9676 (AERE-R-5870) THE USE OF THICK STEEL WRAPPER PLATES FOR LARGE LEAD FILLED FLASKS, WHICH COULD OBVIATE THE NEED FOR SPECIAL THERMAL SHIELDS. Dixon, F. E.; Brook, A. J. (Atomic Energy Research Establishment, Harwell (England)). Sept. 1968. 35p. Dep. CFSTI. UK 9s.

Experimental work with thick steel slabs backed up by lead is described, and the conditions under which lead melting will not take place in the fire test are indicated. The experimental work is confirmed by a computer programme which shows the effects of mill scale and other modifying effects. Calculations are offered showing that this method of construction can be reasonably economical. (auth)

9677 (ARH-952) CRITICALITY PREVENTION DURING THE STORING AND TRANSPORTING OF FISSILE MATERIALS IN THE CHEMICAL PROCESSING DIVISION. Corlew, R. P. (Atlantic Richfield Hanford Co., Richland, Wash.). Dec. 10, 1968. Contract AT(45-1)-2130. 8p. Dep. CFSTI.

Criticality prevention procedures necessary for the safe shipment or receipt of fissile materials in solid or solution form are presented. Responsibilities, posting and labeling requirements, and quantities and forms of fissile materials constituting 20% of a minimum critical mass are included. (H.D.R.)

9678 (CONF-671072-1) SOLIDIFICATION AND LONG-TERM STORAGE OF HIGHLY RADIOACTIVE WASTES. Grover, J. R. (Atomic Energy Research Establishment, Harwell (England)). [1966]. 10p. Dep. CFSTI. UK.

From Symposium on Waste Disposal, London, England.

Various waste solidification processes which have reached an advanced stage of technical development are described. The Waste Calcining Facility at Idaho has been in operation for over three years. The FINGAL development program at Harwell has been completed and the Waste Solidification Engineering Prototype of Brookhaven and Oak Ridge National Laboratories has begun operation. The present system of tank storage will be continued but fixation in some form must be adopted eventually. Since costs of tank storage and fixation are comparable and amount to less than 1% of the cost of nuclear power, it is likely that all highly active wastes will be ultimately stored in a solid form. (F.S.)

9679 (JPRS-46535) EXPERIENCE IN BURIAL OF LIQUID RADIOACTIVE WASTES IN DEEP GEOLOGICAL FORMATIONS. Yudin, F. P.; Pimenov, M. K.; Nazarov, A. I.; Zakharov, S. I.; Metal'nikov, S. V.; Sedov, V. M. Translated from At. Energ. (USSR), 25: 128-33(Aug. 1968). 10p. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 45267. (R.C.K.)

9680 (LA-DC-10032) NUCLEAR SAFEGUARDS APPLICATIONS OF ^{252}Cf. Keepin, G. R.; Walton, R. B. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 33p. (CONF-681032-2). Dep. CFSTI.

From Symposium on Californium-252, American Nuclear Society, New York.

Effective nuclear safeguards and materials management require direct nondestructive, accurate, rapid, quantitative isotopic assay of fissionable and nonfissionable materials. Passive assay and active interrogation methods are described. Active interrogation methods under investigation employ external sources of neutrons to induce fission. Delayed and prompt fission neutrons and gamma radiation are observed for quantitative assay permitting the use of simple inexpensive counting circuitry and minimum data reduction equipment. Equipment using ^{252}Cf is discussed and illustrated. (F.S.)

9681 (ORNL-4316, pp 1-69) RADIOACTIVE WASTE DISPOSAL. Cowser, K. E. (Oak Ridge National Lab., Tenn.).

CALCIUM-45—use as tracer to measure strontium-90 movement through soils
EARTHQUAKES—effects on reactor safety
ECONOMICS—analysis of radioactive waste disposal in salt deposits

KRYPTON-85—dose equivalents to man from, development of equations to predict
NUCLEAR EXPLOSIONS—radiation doses from, computer programs for estimation of
PLOWSHARE PROJECT—radiation doses from, computer programs for estimation of
POPULATIONS—radiation dose rates to, exposed to tritium
RADIATION DOSE—estimations related to peaceful uses of nuclear explosives
RADIOACTIVE WASTE—disposal by hydraulic fracturing, site evaluation for
—disposal in natural salt formations, description of Project Salt Vault for
—storage of high-level solid, development of criteria for long-term
—management of low-, intermediate-, and high-level, long-range study of
REACTORS—safety of, effects of earthquakes on
ROCK—radioactive waste storage in, feasibility studies of
SALT DEPOSITS—radioactive waste disposal in, description of Project Salt Vault for
SODIUM CHLORIDES—diffusion in salt cavities, method for calculation of
—physical properties of, pillar-model studies of
SOILS—radioactive waste disposal in, fate of trace elements and radioisotopes from
—strontium-90 movement through, tracer measurements of
STRONTIUM-85—use as tracer to measure strontium-90 movement through soils
STRONTIUM-90—movement through soils, tracer measurements of
SURFACE WATERS—radioactive waste disposal in, fate of trace elements and radioisotopes from
TRITIUM—dose equivalents to man from, development of equations to predict
—behavior in environment, prediction of long range
—radiation dose rates to man exposed to, estimates of
(R.C.K.)

9682 (ORNL-TM-1637) DEVELOPMENT OF THE WASTE-ASPHALT PROCESS ON A SEMIWORKS SCALE: DESIGN AND INSTALLATION OF EVAPORATOR EQUIPMENT IN BUILDING 4505. Rom, A. M. (Oak Ridge National Lab., Tenn.). Sept. 21, 1966. Contract W-7405-eng-26. 20p. Dep. CFSTI.

A 12-in.-dia wiped-film evaporator (with 4 ft^2 of heating area), along with necessary auxiliary equipment for further "cold" development of the Asphalt-Waste Salts Evaporation Process on a semiworks scale, was installed. The auxiliary equipment includes a 750-gal asphalt storage tank; a 120-gal intermediate-level waste (ILW) feed tank; three pumps; process instrumentation; and miscellaneous interconnecting pipes, valves, and other service items. Approximately six months were required for the detailed design, procurement of equipment, including the wiped-film evaporator (which required five months for delivery), and fabrication and construction. (auth)

9683 (RFP-1242) NEUTRON MULTIPLICATION MEASUREMENTS OF PLUTONIUM INGOTS IN ARRAYS. Ferguson, Donald R. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Dec. 15, 1968. Contract AT(29-1)-1106. 6p. Dep. CFSTI.

Neutron multiplication measurements on partially moderated and partially reflected arrays of 55 gallon drums are presented. Each drum contains a Pu ingot of about 12 kilograms with a density of 15.8 grams per cubic centimeter. (auth)

9684 SHIPPING CONTAINER FOR RADIOACTIVE MATERIAL INCLUDING SAFETY SHIELD MEANS. Bonilla, Charles F. (to National Lead Co.). U. S. Patent 3,414,727. Dec. 3, 1968. Filed Apr. 26, 1965.

A shipping container for radioactive material includes a central cavity surrounded by radiation shielding material. The shielding material is in turn surrounded by a safety shield. An enclosed space containing a shield substance which melts at a temperature lower than the radiation shielding material and is adapted to flow out of the enclosed space through discharge means when subjected to external heat is included. (Offic. Gaz.)

9685 A REMOTE HANDLING DEVICE FOR A NUCLEAR REACTOR. Gugenberger, Rene; Tissot, Roland (to Commissariat a l'Energie Atomique). British Patent 1,139,876. Jan. 15, 1969. Priority date Jan. 4, 1967, France.

A compact remote handling device for reactor fuel elements is described. The device consists of a gripper suspended from a chain which is stored in a reservoir. Indented wheels guide and move the chain. The wheels are located along the path of the chain between the storage reservoir and the gripper. A motor is provided for operating the wheels. (F.S.)

9686 RADIOACTIVE EFFLUENT CONTAINER. Erard, M. Bull. Inform. Sci. Tech. (Paris), No. 130, 61-7(Oct. 1968). (In French).

The specifications of a container known as the "C 17 container," designed for the transport of radioactive materials, which constitutes a "B" type unit according to the official regulations are presented. Its useful capacity is 100 liters. The container consists of an outer packing and a confining envelope, which may be either a stoppered cask, in the case of liquid transport, or a completely open cask containing a polyvinyl chloride bag or a polyethylene carboy (for a small volume of concentrated liquid). Two prototypes were tested which successfully withstood the prescribed mechanical (9 m fall and 1 m fall on a pile) and thermal tests (900°C for ½ hour). (auth)

9687 LIFTING GEAR FOR A HOT CAVE OR A RADIOACTIVE-MATERIAL STORAGE. Matsumoto, Tokutaro (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-21277. Sept. 6, 1968. Filed Jan. 22, 1965.

The lifting gear is described that is safe in the handling of a bottle containing a radioactive material; is of simple construction; and low in cost. An outer and an inner cylindrical bottle support can move up and down through a shielded tower, the bottom end of which opens into the hot cave. The inner cylindrical support is normally set within the outer cylindrical support, locked by a means installed on the inside surface of the latter support. A wire runs from a middle point on the tip of the inner support through a pulley at the upper end of the outer support, another at its bottom end runs through a pulley at a point midway on the inside surface of the tower to the outside winding device. By winding the inner support can be brought near the top end of the outer support. A rod penetrating through the wall opposite to the "pulley" wall is available to release the locking mechanism. A bottle suspended from above is received into the inner support when the support is raised. (NSA of Japan)

9688 RADIATION SHIELD. Ueda, Kazunari (to Mitsubishi Atomic Power Industries Ltd.). Japanese Patent 1968-20240. Aug. 30, 1968. Filed Dec. 1, 1965.

A radiation shield is described that may be used for both neutrons and gamma radiation simultaneously. Two shields are located in the same container. Neutron shielding plates and gamma shielding plates are placed alternately one upon the other with the gamma plates located on the outer layer. The plates are sealed in the common container. (NSA of Japan)

9689 CONTAINER FOR A FAILED FUEL. Hiruta, Yasuo (to Hitachi Ltd.). Japanese Patent 1968-21278. Sept. 6, 1968. Filed Feb. 4, 1965.

A container for failed fuel elements is described in which water in the container may be released when the container is closed in pool water and also by the heating of water by decay heat of the contained fuel. The container body itself has a space in the bottom portion which is produced by a concave-plate partition. A downward protrusion, through which a hole is cut, is made at the center of the plate. The top portion of this hole is made into the shape of a cone. A sphere is pushed against the cone from below by means of a spring which is fixed at the bottom end of the hole. (NSA of Japan)

9690 RADIATION-SOURCE TRANSPORT CONTAINER. Oishi, Mineo (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1968-22797. Sept. 25, 1968. Filed Feb. 19, 1966.

A radiation source container is described in which the inside of the container may be seen through a shield window. The radiation source transport container consists of a cylindrical container which has deep-wave shaped cuts on the two opposed sides from the top end and circumferential steps made on the inside narrowing into the center of the body and a plug which fits into the "cuts and steps" of the container. (NSA of Japan)

Vacuum Engineering

9691 COMPARISON OF SPUTTER-ION PUMP AND REDHEAD GAGE AS APPENDAGE PUMPS. Burroughs, E. G. (Night Vision Lab., Fort Belvoir, Va.). Rev. Sci. Instrum., 40: 182-3(Jan. 1969).

A comparison test of an NRC Redhead gage and a Varian 1 liter/sec ion pump was conducted. It was seen that the ion appendage pump could not produce pressures of 10^{-9} torr and lower. In addition to giving a pressure measurement below 10^{-9} torr, the Redhead gage performed as a satisfactory vacuum pump, even to the extent of pumping the ion pump outgassing load. (W.H.K.)

9692 DIFFERENTIAL ION PUMPING FOR VACUUM DEPOSITION. Leonard, W. F. (Southern Methodist Univ., Dallas). Rev. Sci. Instrum., 40: 187-8(Jan. 1969).

A differentially pumped evaporator is described. The basic system consists of two bakeable chambers — a substrate chamber and a source chamber — connected by a plate with a small conductance tube which allows the vapor to traverse to the substrate. This arrangement confines the gases generated by the source to the source chamber during evaporation and maintains a large differential pressure. Both chambers are electronically pumped (140 liter/sec Vac Ion pumps) and have ultimate pressures of 5×10^{-11} torr. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 10961.

General Detectors and Monitors

Refer also to abstracts 10884, 10936, and 11300.

9693 (BNL-12981) SEARCH FOR NEUTRINOS FROM THE SUN. Davis, Raymond Jr. (Brookhaven National Lab., Upton, N. Y.). [1968]. 30p. (CONF-680936-1). Dep. CFSTI.

From Meeting on Neutrino Physics, Moscow, USSR.

A solar neutrino detector has been built that is based upon the ^{37}Cl $(\nu,e^-)^{37}Ar$ reaction. The detector uses 3900,000 liters of tetrachloroethylene as the neutrino capturing medium. Argon is removed from the liquid by sweeping with helium gas, and counted in a small low level proportional counter. The recovery efficiency of the system was tested with ^{36}Ar by the isotope dilution method, and also with ^{37}Ar produced in the liquid by fast neutrons. These tests demonstrate that ^{37}Ar produced in the liquid by neutrino capture can be removed with a 95 percent efficiency by the procedure used. Initial results with the detector show that the neutrino capture rate was less than 0.5 per day, corresponding to a total neutrino flux-cross section product of less than 3×10^{-36} sec^{-1}. From this limit and the cross sections of Bahcall, the following conclusions were drawn: (1) the flux of neutrinos from ^8B decay in the sun was less than 2×10^6 cm^{-2} sec^{-1}; (2) less than 9 percent of the sun's energy is produced by the CNO-cycle; and (3) the extraterrestrial flux of 1, 10, and 100 MeV neutrinos is less than 5×10^9, 13×10^8, and 4×10^2 cm^{-2} sec^{-1}, respectively. The ultimate detection sensitivity of the present experiment is limited by background effects from cosmic radiation and internal contamination with natural alpha emitters. Knowledge of the magnitude of these background effects shows that the ultimate neutrino detection sensitivity can be increased five-fold. A brief survey is given of possible low threshold radiochemical neutrino detection techniques that could be used for observing low energy neutrinos from the sun. (auth)

9694 (BNWL-SA-2128) METHODS OF MEASUREMENT AND INTERPRETATION OF RESULTS IN RADIATION MONITORING AND DOSIMETRY. Unruh, Carl M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1968. Contract AT(45-1)-1830. 36p. (CONF-681203-1). Dep. CFSTI.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India.

A procedure for planning and developing a radiation monitoring and dosimetry program is described. Four factors which must be considered in the selection of the monitoring and dosimetry instrumentation are discussed. These factors are need, selection, calibration, and interpretation. (W.H.K.)

9695 (CEA-R-3620) DETECTION OF AN INTENSE BEAM OF POLYCHROMATIC GAMMA RAYS MODULATED AT 3000 MHz. Beil, Hans; Veyssiere, Andre; Daujat, Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct. 1968. 19p. (In French). Dep.

Two methods of detection of a γ beam modulated at very high frequencies are presented. The intense modulated beam is created by means of Bremsstrahlung in a gold-target, the latter having been placed in the emerging electron beam of the Linac at Saclay. A tentative interpretation of the physical phenomena involved in the detection processes is also given. The empirical data agree reasonably well with numerical evaluations based on well established theoretical concepts concerning these phenomena. (auth)

9696 (CEA-R-3631) STABILIZED CONSTANT POWER SUPPLY. Roussel, Louis (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etude Nucleaires). Oct. 1968. 123p. (In French). Dep.

Thesis.

The study and realization of a stabilized power supply variable from 5 to 100 Watts are described. In order to realize a constant power drift of lithium compensated diodes, a 1 percent precision of regulation and a response time less than 1 sec was investigated. Recent components like Hall multiplicator and integrated amplifiers give this possibility and it is easy to use permutable circuits. (auth)

9697 (EUR-4063) FABRICATION OF ENCAPSULATED Ge(Li) DETECTORS FOR γ-SPECTROSCOPY. Meyer, H.; Eschbach, H. L.; Nagel, W.; Kruidhof, E. W. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). Sept. 1968. 21p. Dep.

The procedure and the equipment for the fabrication of encapsulated Ge(Li) detectors are described. The detector crystals are placed in aluminum capsules hermetically sealed by cold pressure welding. The important details of the welding process to ensure reliable welds are discussed. Proper crystal mounting, clean helium atmosphere in the capsules and a carefully constructed feedthrough avoid biasing limitations and allow long term stability of the detector characteristics. Background degradation due to the encapsulation of detectors irradiated with γ-rays was not detected. (auth)

9698 (INSJ-108) PROPERTIES OF SAKURA NUCLEAR EMULSIONS IN LOW ENERGY. Nagoshi, Chieko (Tokyo Univ. (Japan). Inst. for Nuclear Study). Sept. 1, 1968. 24p. Dep.

The relation of grain density to particle velocity was determined for Sakura nuclear emulsions for low-energy alpha particles, deuterons, helium-3 ions, and protons. These grain density measurements are useful for particle track discrimination. (W.H.K.)

9699 (PHS-999-RH-32) COMMON LABORATORY INSTRUMENTS FOR MEASUREMENT OF RADIOACTIVITY. Interlaboratory Technical Advisory Committee Report No. 2. Environmental Health Series: Radiological Health. Rushing, D. Edward; Coulter, Robert W.; Drobinski, Joseph C. Jr.; Phillips, Charles R.; Remark, Donald G.; Shearer, S. David; Shuping, Ralph E.; Smith, Allan E.; Stoms, Richard K. (National Center for Radiological Health, Rockville, Md.). Apr. 1967. 104p. GPO.

The operation and performance of proportional and scintillation counters for alpha detection and Geiger–Mueller, proportional, and scintillation counters for beta detection are described. Also, the operation of pulse-height analyzers and scintillation gamma spectrometers is discussed. (W.H.K.)

9700 (RCN-98, pp 161-80) EXPERIMENTAL STUDY OF NEUTRON DETECTORS FREQUENCY RESPONSES. Mogilner, A. I.; Krivelev, L. P.; Morosov, S. A.; Shvetsov, D. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut).

The application of many statistical methods in supplement to reactor technique requires the knowledge of the frequency response of used detectors. In literature there are both theoretical and experimental data dedicated to this question. Similar work was performed in the Institute of Physics and Power. The frequency responses of different gas-filled and solid covered counters and chambers were measured. The measurements were performed with the help of a Po–Be neutron source. For all detector types frequency responses as a function of the applied potential were obtained. For the fission chamber frequency characteristics as a function of the pressure of the gas-filled mixture were defined. The investigations were performed in the frequency range from 20-80 Hz to 10-20 kHzs. Finally it was found that the frequency response in the mentioned frequency range was generally determined by one collection time, caused by ion drift velocity. A consequence of this is the fact that the frequency responses for almost all the examined detectors are satisfactorily being described by the expression $a + b/(\omega^2 + \xi^2)$, where a and b are constants, ξ is break frequency. The value of ξ is linearly dependent on the detector applied voltage in a wide range of voltage and pressure change. (auth)

9701 BETA-CONVERSION ELECTRON COINCIDENCE MEASUREMENTS USING Si(Li) DETECTORS. Daniel, Charles Dwelle Jr. New Orleans, Tulane Univ., 1968. 125p.

Thesis.

The research described was performed during the period November 1961–July 1963. At the end of the period the author resumed his duties with the U. S. Army and completed the analysis and the writing of the dissertation while assigned in the Washington, D. C. area and in Viet Nam. The dissertation covers the fabrication of Si(Li) semiconductor, charged-particle detectors and their use in beta-conversion electron coincidence measurements. The technique of fabrication which was developed proved to be reliable, surprisingly simple and very flexible. The experimental methods developed in obtaining the measurements with the completed detectors and electronic equipment resulted in quite reproducible and reliable data on the isotopes investigated. By employing a computer program adapted for use on the Tulane

University IBM 1410 Computer the Fermi–Kuri plot of the beta spectra was developed from the coincidence spectra obtained with the assembled equipment. The resulting log ft values and end point energies are presented. Also described are preliminary measurements for beta-conversion electron angular correlation experiment. Iodine-131 was used as a source in an experimental arrangement employing a Seigbahn–Slätis intermediate-image spectrometer, Si(Li) detectors, and the necessary electronics to determine coincidence and measure energy. (Disser. Abstr.)

9702 TRUE RANDOM RATEMETER WITH AUTOMATIC DEAD-TIME CORRECTION FOR DUTY FACTORS UP TO 99 PERCENT. Metz, A. J.; Howard, R. H. (Argonne National Lab., Ill.). Rev. Sci. Instrum., 40: 16-20(Jan. 1969).

A true random ratemeter which automatically corrects for dead time is described. The unit requires two inputs: the normal pulse input and a signal whose duration equals the dead time of the channel being monitored. Variations in dead time, whether they are random or not, are automatically accommodated. Accuracy is 1% on all ranges even at duty factors up to 99%. (auth)

9703 LIVE-TIMER METHOD OF AUTOMATIC DEAD-TIME CORRECTION FOR PRECISION COUNTING. Porges, K. G.; Rudnick, S. J. (Argonne National Lab., Ill.). Rev. Sci. Instrum., 40: 1-8(Jan. 1969).

Several applications of live-timer count correction are discussed with regard to the precision and statistical accuracy of results obtained. The method is compared to conventional real-time operation with subsequent formula correction. For straightforward high-precision counting, the live-timer method is believed to be superior. Counting of sources which decay appreciably during the count, sometimes thought to be a case where automatic live-timer correction fails, can be accomplished by choosing a certain readily calculable ratio of clock inhibit duration to paralysis. Similarly, coincidence counting with different channel paralyses is found to be amenable to live-timer correction, with a resulting precision which exceeds that of formula corrections. (auth)

9704 CHANNELTRON FATIGUE AND EFFICIENCY FOR PROTONS AND ELECTRONS. Egidi, A.; Marconero, R.; Pizzella, G.; Sperli, F. (Univ., Rome). Rev. Sci. Instrum., 40: 88-91(Jan. 1969).

The behavior of two type-4013 Bendix Channeltrons as single particle detectors has been investigated and the efficiency of detection for protons and electrons has been measured in a vacuum of 10^{-6} torr. It has been established that under electron bombardment the gain decreases with time approaching an asymptotic value G_∞ which depends only on the intensity of the incident flux. An empirical formula for the dependency of G_∞ on the flux in the range 10^3 to 10^6 electrons/sec has been derived, $G_\infty = (1.3 \times 10^{10})/J$, where J is the incident flux measured in electrons per second and the high voltage applied to the Channeltron is 3 kV. When the bombarding beam is turned off the gain is always found to recover its initial value. The efficiency for electrons and protons does not show any dependency on the gain or on the particular Channeltron used. (auth)

9705 C–Al PARALLEL PLATE DYNODE ELECTRON MULTIPLIER. Kanayama, M.; Konno, T.; Kiyono, S. (Tohoku Univ., Sendai). Rev. Sci. Instrum., 40: 129-32(Jan. 1969).

An easy method of making a parallel plate electron multiplier, which is used for detection of x rays, electron beams, and charged particles, is developed. The multiplier consists of two continuous dynodes, which are prepared by evaporating aluminum onto glass substrates on which carbon has been evaporated in advance. The gain is in the range of 10^8 to 10^9, when the applied voltage is 3 kV. Some of the features are good linearity of response except for the saturation region, extremely small noise and long lifetime, and ease in handling. It also can be used for pulse counting techniques. (auth)

9706 METHOD FOR TIME SAMPLING THE ANODE CURRENT OF MAGNETIC ELECTRON MULTIPLIERS. Morack, J. L.; Fairchild, C. E. (Oregon State Univ., Corvallis). Rev. Sci. Instrum., 40: 184-5(Jan. 1969).

The commercial Bendix magnetic electron multipliers (MEM) have proved to be useful for the detection of particles and extreme ultraviolet photons. For such applications it may be desirable to replace their standard anode by a structure which allows sampling of the anode current. One such modification which allows the anode current of a Bendix model M-308 MEM to be repetitively sampled with subnanosecond switching times is described. (auth)

9707 COUNTING TIMES IN THE MEASUREMENT OF RADIOACTIVITY. England, J. M.; Miller, R. G. Jr. (Stanford Univ., Stanford, Calif.). Int. J. Appl. Radiat. Isotop., 20: 1-10 (Jan. 1969).

The activity of a radioactive source is estimated in terms of the ratio of the number of recorded counts to the length of recording time, and the detection efficiency of the counter. If background radiation is appreciable, the count rate with the source in position must be corrected for the count rate due to background. The source and background are measured for either (a) a fixed length of time or (b) a fixed number of counts. Simple charts are presented which enable the investigator to determine the measuring time, or number of counts required to control the precision of the corrected source count rate when (i) equal time is allocated to source and to background, (ii) equal number of counts are allocated to source and to background, and (iii) time is allocated optimally to the background and to K different sources. (auth)

9708 THE MEASUREMENT OF LOW ENERGY X-RAYS. V. TOTAL ABSORPTION SILICON DEVICES. Greening, J. R.; Randle, K. J.; Redpath, A. T. (Univ. of Edinburgh). Phys. Med. Biol., 14: 55-60(Jan. 1969).

A description is given of the use of silicon barrier layer and lithium drifted detectors for the measurement of x-rays generated at 10 to 30 kV. Defined x-ray beams are totally absorbed in the silicon and, by comparing the charge so produced with the beam energy as measured with a total absorption calorimeter, a value of 3.69 ± 0.02 eV per electron-hole pair in silicon is derived. The saturation characteristics of the devices are discussed, together with their merits for x-ray measurement. (auth)

9709 DETERMINATION OF THE COUNTING EFFICIENCY FOR SULPHUR PELLETS CONTAINING ^{32}P. Koehler, W. (International Atomic Energy Agency, Vienna). Int. J. Appl. Radiat. Isotop., 20: 33-42(Jan. 1969).

The determination of fast neutron flux densities is often performed by the (n,p) reaction on ^{32}S. Due to the β-selfabsorption in irradiated sulfur pellets, the accurate determination of the induced activity is difficult. The counting efficiency of a 2π-methane flow proportional counter for thick sulfur pellets (ϕ = 10 mm) containing ^{32}P was determined by three different methods. The mean deviation of the three methods from the weighed mean value 0.8 per cent. The counting equipment is used for measuring irradiated sulfur pellets, by means of which other counting apparatus may be calibrated. A method is described for handling the data for obtaining comparable values of the neutron fluence despite small variations in the differential flux densities. (auth)

9710 NEUTRON DETECTOR. (to Kewanee Oil Co.). British Patent 1,138,914. Jan. 1, 1969. Priority date Mar. 10, 1966, United States.

The design of a scintillation detector which operates at wide temperature variations for detection of neutrons is described. (B.G.D.)

9711 SOLID STATE ENERGY-RESPONSIVE LUMINESCENT DEVICE. (to Matsushita Electric Industrial Co., Ltd.). British Patent 1,138,947. Jan. 1, 1969. Priority date Dec. 23, 1964, Japan.

A solid state energy-responsive display apparatus, comprising an energy-responsive element the electric impedance of which varies in accordance with the intensity of an incident energy, and a luminescent element, the intensity of luminescence of which varies depending on the strength of an electric field applied thereto is described. Such an energy-responsive element has been in the form of a photo-conductive element the electric impedance of which reduces when the element is excited by an energy such as light, radiation, electron beam and the like, while such a luminescent element has been in the form of an electroluminescent which is responsive to pulsing or alternating electric field applied thereto, the intensity of its luminescence varying in accordance with the applied electric field. Moreover, various types of solid state energy-responsive display apparatus have been proposed, examples thereof being solid state light amplifiers, solid state image reversing amplifiers and the like. (B.G.D.)

9712 CATHETER-TYPE SEMICONDUCTOR RADIATION DETECTOR AND ITS MEDICAL APPLICATION. Ueda, Hideo (Tokyo Univ.); Takayanagi, Seiichi. Toshiva Rebyu, 23: 1595-9(Dec. 1968). (In Japanese).

A catheter-type semiconductor radiation detector that can be safely inserted into a living body to measure local radioactivity has been developed. The standard detector measures 3.2 mm in diameter and about 120 cm in length. Other developments are: one measuring 2.7 mm in diameter, and a special detector, 2.5 mm in diameter, for detection of gastric cancer, to be fitted into the lumen of a gastrofiberscope where a biopsy forceps is inserted. Several applications of the detectors to clinical medicine are described briefly herein: measurement of blood flow, such as continuous measurement of cardiac output and myocardial blood flow;

measurement of blood circulation time, such as detection of intracardiac shunt; diagnosis of upper gastrointestinal tract cancer. (NSA of Japan)

9713 STATISTICAL ERRORS IN THE MEASUREMENT OF ACTIVITY OF BETA RAYS WITH LIQUID SCINTILLATORS BY THE DOUBLE OR TRIPLE COINCIDENCE METHOD. Hoegl, A.; Mueller, H.; Schwerdtel, E. (Frieseke and Hoepfner GmbH, Erlangen, Germany). Int. J. Appl. Radiat. Isotop., 20: 69-75(Jan. 1969). (In German).

It is shown how the statistical errors of the number of counts in double and triple coincidence influence results calculated for the activity. Diagrams are given for the determination of errors. (auth)

9714 QUANTITATION OF THE OUTPUT OF A SCINTILLATION CAMERA IN DYNAMIC STUDIES. Westerman, B. (Royal Postgraduate Medical School, London). Phys. Med. Biol., 14: 39-44(Jan. 1969).

A method by which the output from a γ-camera is recorded on analog magnetic tape is described. Subsequent quantitative information is obtained, using a photocell positioned over a delineated area of an oscilloscope screen, as a light dot counter. The accuracy of the method has been tested when analyzing flow rates. (auth)

9715 ENERGY-LOSS STRAGGLING OF PROTONS IN SILICON. Kolata, J. J. (Michigan State Univ., East Lansing); Amos, T. M.; Bichsel, Hans. Phys. Rev., 176: 484-9(Dec. 10, 1968).

The energy-loss straggling distributions for protons incident on a 200-μ silicon surface-barrier detector were measured in the energy region between 5 and 42 MeV. Experimental results were compared to the predictions of the Vavilov theory and found to be in excellent agreement at the higher energies. However, a systematic difference between theory and experiment was observed for proton energies less than 20 MeV, the discrepancy increasing with decreasing incident proton energy. This effect is due to appreciable variation of proton energy over the thickness of the detector. Tschalär's distribution functions, which specifically consider this variation, yield good fits to the data for energy losses as much as 80% of the incident proton energy. (auth)

9716 AN APPARATUS FOR ANALYZING THE NEUTRON RESONANCE OF THE ELEMENTARY COMPONENTS OF A MATERIAL. Gambaryan, R. G.; Rogov, E. V.; Shtan, A. S. At. Energ. (USSR), 25: 237-8(Sept. 1968). (In Russian).

An instrument was developed for determining rapidly the presence of elements possessing abnormally high neutron-resonance properties by measuring the resonance-neutron absorption in the material on the basis of self-shielding. The absorbed resonance neutrons were determined by the difference of 2 β-activity measurements of the resonance indicator, with and without a resonance filter. The apparatus consisted of a plastic-lined moderator-shield block and an automatic control unit. The block included channels for 2 isotropic neutron sources and 2 resonance filters; a lead shield protected the counters against the emitted γ-radiation. The induced activity of the indicators may be recorded with zero activity or after reaching the dynamic saturation state. The experiments were carried out with 2 Pu-Be neutron sources with a flux of less than 10^7 neutrons per second. (TTT)

9717 LOW-INTENSITY NEUTRON FLUX DETECTOR. Sokolova, Z. Ya.; Chernyaev, V. B. At. Energ. (USSR), 25: 238-9(Sept. 1968). (In Russian).

In measurements involving slowing down of fast neutrons, the geometry of the moderator and the type of the detector determine the efficiency method. When measuring low neutron fluxes, solid-scintillator detectors are usually employed. A very effective detector, based on $ZnS(Ag) + B_2O_3$ was developed; the scintillator was placed on a large portion of a light guide which also served as a moderator. In order to record neutrons within a broad energy range, the scintillator was distributed at various depths of the moderator. The output signals were sent to photomultipliers of varying sensitivity, making it possible to change the background. The sensitivity of the detecting circuit toward γ radiation was determined at several levels. Up to 60 mR/sec, the γ radiation caused noticeable errors at an efficiency of 10% or less; however, the error due to γ radiation increases measuring low fluxes, of the order of the background. Therefore, low-flux sources should be measured at discrimination levels, at which the background does not exceed 2 pulses/minute. The recording efficiency is also affected by the location of the detector and the volume of the moderator and the dimensions of the source. (TTT)

9718 GAS, LOW PRESSURE, DIFFERENTIAL REGULATOR. Montag, M. (to United States Atomic Energy Commission). U. S. Patent 3,421,543. Jan. 14, 1969.

An easily adjustable, sensitive, gas pressure regulator for preventing both positive and negative over-pressure in large area hodoscopes for high energy charged particle detection is described. It consists of a valve body and float vertically movable on a liquid level means wherein the valve body moves vertically downward in a top located inlet to permit gravity and inlet gas flow to close the valve and wherein the liquid level means tends to reach an equilibrium to cause means responsive to the upward movement of the float to close a top located outlet. (AEC)

9719 IMPROVEMENTS IN OR RELATING TO ANALOGUE TO DIGITAL CONVERSION SYSTEMS. (to Japan Atomic Energy Research Inst.). British Patent 1,140,074. Jan. 15, 1969. Priority date Mar. 12, 1965, Japan.

An analog-to-digital converter is described for use with a multichannel pulse-height analyzer for analysis of pulses from nuclear radiation detectors. (B.G.D.)

9720 ALPHA PARTICLE REGISTRATION IN PLASTICS AND ITS APPLICATIONS FOR RADON AND NEUTRON PERSONNEL DOSIMETRY. Becker, Klaus (Oak Ridge National Lab., Tenn.). Health Phys., 16: 113-23(Feb. 1969).

The number and size of visible alpha particle tracks in different cellulose derivatives (nitrate, acetate, acetobutyrate, and propionate) and other polymer foils depend mainly on the chemical structure and physical treatment of the foils, the presence or absence of oxygen during irradiation, the humidity and/or chemical pre- or post-treatment of the foils, and on the etching conditions. The stability of unetched tracks decreases close to the softening temperature of the plastics. Up to 100°C the fading in the investigated foils was small. Cellulose derivates are most suitable for several applications, such as simple and inexpensive personnel dosimetry of radon and radon daughters in uranium mines; thermal neutron dosimetry using (n,α) reactions in B, Li, etc.; and fast neutron measurements via (n,α) reactions and recoil reactions in the foil. The sensitivity of this method is superior to the fission fragment registration method above 1 MeV, but there is a directional dependence up to −30%. Very high energy neutrons can also be measured via spallation in high-Z cover materials. Some depth–dose measurements for neutrons of different energies are reported. (auth)

9721 RADIATION MONITOR WITH ADJUSTABLE ALARM. Taylor, W. B.; Hunziker, E.; Cunningham, J. R. (Ontario Cancer Inst., Toronto). Phys. Med. Biol., 14: 136-8(Jan. 1969).

The device described was designed to operate in the treatment areas of a large radiotherapy center. Its specific purpose is for integration into the interlocking systems of a therapy unit, so that in the event of mechanical or electrical failure an alarm will be given if the radiation beam of the unit remains on after the entrance door to the treatment unit has been opened. The alarm is audible at a level that is easily discernible by the technician, but not such as to cause undue alarm to the patient. The device is either mains or battery operated and serves the additional new function of being capable of simple detachment from the interlock system and usable as a self-contained radiation monitor. The threshold at which the alarm rings has been made adjustable, so that it can be adapted to a number of different room layouts or operating conditions. A block diagram of the instrument is shown. It comprises a pulse shaper and diode pump, an alarm with threshold setting, a D.C. to D.C. converter and a high voltage supply. (auth)

9722 DETECTION OF PLUTONIUM ON AIR FILTERS USING THE α/β RATIO OF RESIDUAL THORON DAUGHTER ACTIVITY. Lindeken, C. L.; Denham, D. H. (Univ. of California, Livermore). Health Phys., 16: 235-8(Feb. 1969).

The relative constancy of the ratio between the α and β activities of natural airborne radioactivity and the increase in this ratio when long-lived α-activity is present in the air being sampled has been suggested for detection of airborne Pu, and the ratio has formed the basis for continuous monitoring, or α and β counting soon after sample collection. In either case the observed ratio is determined predominantly by the radon daughters, since these exceed the activity concentration of thoron daughters in the atmosphere by factors of 10 to 100. In studies at Livermore it was found, however, that detection sensitivity based on changes in the α/β ratio of radon daughters is variable, and at normal concentrations of about 100 pCi/m^3 1 MPC of Pu does not provide a statistically significant ratio change, when sampling at 3 cfm for 8-hour periods. Radon daughters decay with a half-life of about 30 min., whereas thoron daughter decay is controlled by the 10.6 hour half-life of ThB; hence if the samples are allowed to decay for about 6 hours before counting, the α/β ratio is established by thoron daughters, and at normal daytime thoron daughter concentrations the residual activity is low enough to allow 1 MPC of Pu to be detected easily by the ratio change after an 8 hour sampling period. Some one-year studies con-

ducted in the Plutonium Metallurgy Building at Livermore using the thoron daughter method are described. A nomograph is given for estimating the airborne Pu concentration in terms of MPC from the α/β ratio, and an example of its application is given. It was concluded that ^{239}Pu at airborne concentrations <1 MPC can be detected from the increase in the α/β ratio of thoron daughter activity on a sample filter. The technique has proved useful in tracing sources of low level activity releases, but its principal advantage is that air monitoring data for the previous day's operations are available before the next day's operations begin. (UK)

9723 COMPACT BATTERY-OPERATED RATEMETER EMPLOYING "BOOTSTRAPPING" TO ELIMINATE CABLE CAPACITANCE EFFECTS. Kemp, L. A. W. (London Hospital, Eng.). Phys. Med. Biol., 14: 133-5(Jan. 1969).

A Geiger counter with its normal high resistance load is best operated with a high imput impedance circuit. The cable capacitance may have serious shunting effects on pulse height and shape where a long lead or lead of high intrinsic capacitance is required, and the use of a head pre-amplifier as a buffer stage is undesirable or impossible. The use of a low value Geiger load resistor to minimize pulse distortion results in serious signal loss, necessitating a high gain multistage amplifier. A solution to these difficulties, of wide applicability, consists essentially of bootstrapping the cathode of the counter, via an RC coupling, to the output of an emitter-follower cascade coupled to the high resistance Geiger counter load, the latter being in the counter anode lead. In this way the counter pulse is made to appear also on the outer screen of the cable, via which the cathode connection is made. Thus the capacitor comprised by the cable is not charged by the pulse, and its effect on both pulse amplitude and shape is virtually eliminated. The ratemeter in which this simple circuit expedient was incorporated was a self-contained, battery operated, and earth-free unit with low overall stray capacitance to earth; its circuit is shown. The instrument was designed primarily for operating theatre use. (UK)

9724 CONTINUOUS MEASUREMENT OF NATURAL RADIOACTIVITY IN THE NEAR-GROUND ATMOSPHERE BY IONIZATION CHAMBER. Murayama, N.; Okoshi, N. Kishocho Kenkyu Jiho, 20: 329-38(June 1968). (In Japanese).

Two modified Kawano type ionization chambers for $\alpha\beta\gamma$ and $\beta\gamma$ ray measurements were constructed, and the long-time observation of natural radioactivity was continuously carried out at the Mito weather station. Details of instrument and working characters, especially feasibility for routine observation are described. Time variations, i.e. diurnal and seasonal variations, of the natural radioactivity are also presented. Correlation of natural radioactivity with meteorological elements, i.e. air pressure, temperature or wind, is shown with a few examples. Lastly it is found that the abrupt temporary drop of $\alpha\beta\gamma$ radiation appears in association with the early formation of nocturnal temperature inversion at the lower levels. (auth)

9725 DETERMINATION OF THE GROUND DEPTH FROM ABSORPTION OF MUONS. Hofmokl, Helena; Stefanski, Wlodzimierz (Inst. of Nuclear Research, Lodz, Poland). Nukleonika, 13: 1101-9(1968).

Two series of experiments have been performed using a four-fold G.M. counter telescope. The first series of experiments was made in the underground laboratory 12.45 m below the ground level and the second on the surface 217 m above the sea level. The thickness of the layer of the interposed earth and concrete was measured in m.w.e., in radiation length and in nuclear interaction length. It was calculated that a 12.45 m layer of ground and concrete corresponds to 21.52 m.w.e., 72.2 units of the radiation length, and 22.4 units of the nuclear interaction length. The energy of the muons observed in the underground laboratory is equal to 5.49 GeV. The mean density of the interposed earth was equal to 1.73 gcm^{-3}. (auth)

9726 THE SCINTILLATION METHOD OF BETA EMITTERS ACTIVITY MEASUREMENTS BY COUNTING OF ELECTROMAGNETIC RADIATION. Radoszewski, Tomasz (Instytut Badan Jadrowych, Swierk, Poland). Nukleonika, 13: 1161-9(1968). (In Polish).

A relative method for measuring the activity of pure β-emitters in liquid form has been investigated. The scintillation counter with a NaI(Tl) crystal has been applied in which the x-rays produced by absorption of β-particles were counted. The efficiencies of counting for ^{14}C, ^{35}S, ^{204}Tl, ^{32}P, ^{90}Sr, and ^{90}Y nuclides were calculated by calibration against standard solutions of these nuclides. The possible counting errors in the proposed method have been investigated. (auth)

9727 SCINTIGRAPHY: ADVANCES CONTINUE. Int. At. Energy Agency Bull., 10: No. 6, 23-7(1968).

The equipment and techniques used in scintillation scanning for medical purposes are reviewed. (B.G.D.)

9728 SCINTILLATION DETECTOR USING A SINGLE CRYSTAL OF GALLIUM ARSENIDE. Leventhal, Edwin A.; Neumark, Gertrude F.; Rittner, Edmund S. (to North American Philips Co., Inc.). U. S. Patent 3,415,989. Dec. 10, 1968. Filed Feb. 3, 1966.

An improved scintillation detector for x-ray and nuclear radiations is described which exhibits improved energy resolution. In the preferred form, the detector comprises a single crystal of gallium arsenide. One end of the gallium arsenide crystal is used as a scintillator to convert the incident radiation into photons. The opposite end of the crystal is provided with an internal p-n junction acting as a photodetector for the photons generated within the first end. The two regions of the crystal are given compositions to ensure that the photons generated at the scintillating end are transmitted whereas the same photons are strongly absorbed in the photodetecting end. These results are achieved by changing the bandgap or by appropriate doping with impurities. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 9299 and 9306.

9729 (AERE-R-5897) POSITION SENSING DETECTOR ARRAY FOR A CHARGED PARTICLE MAGNETIC SPECTROGRAPH. Allan, D. L.; Ansell, G. V.; Jolly, R. K. (Atomic Energy Research Establishment, Harwell (England)). Sept. 1968. 13p. Dep. CFSTI. UK 3s.

An array of eight position-sensing detectors was mounted in the focal plane of the Harwell broad range charged particle magnetic spectrograph and used successfully to measure the deuteron spectrum from the reaction $^{56}Fe(d,d')$ at $E_d = 11.5$ MeV. The method of mounting the detectors, and the operation of the associated electronic circuitry, are described. (auth) (UK)

9730 (KURRI-TR-41) RESEARCH-REPORTS MEETING ON β-γ-RAYS, AND THEIR INSTRUMENTS. Horie, Hisashi (Tokyo Inst. of Tech. (Japan)); Matsui, Hiroshi; (and others). 1967. 79p. (In English and Japanese). (CONF-670656). Dep.

Due to the importance of measuring instruments, a research reports meeting on June 19 and 20, 1967, was held on the β and γ rays and their measuring instruments. Reports presented at the meeting are given in the form of short articles: anomalous parity states in odd-A nuclei; excited levels in ^{152}Gd, excited levels in ^{100}Ru and ^{102}Ru, short-lived activities produced by fast neutron bombardment, $\vec{\mu}$, Q measurements of anomalous coupling states by the spin orientation method, multicounter goniometer, β-γ angular correlation and internal bremsstrahlung, improvement of β-ray spectrometer, Kakuken ρ = 75 cm air-core spectrometer, Riken $\sqrt{2}\pi$ air-core β-ray spectrometer, new spectrometers, data acquisition and analysis system, Ge(Li) detectors, semiconductor detector amplifiers, neutron capture γ-ray measurements by Ge(Li) detector, measurements of low-energy γ rays and internal conversion electrons, and e-γ angular corelation measurement by Si(Li) detector. (NSA of Japan)

9731 (NYO-3136-6) QUANTITATIVE AND COMPUTER METHODS APPLIED TO THE STUDY OF HUMAN AND ENVIRONMENTAL RADIOACTIVITY. Annual Progress Report, October 1, 1967-September 30, 1968. Pasternack, Bernard S. (New York Univ., N. Y. Inst. of Environmental Medicine). Contract AT(30-1)-3136. 101p. Dep. CFSTI.

A rapid technique to determine radon daughter working levels, nonlinear regression analysis of gamma spectrometer data with an application to the assay of human radioactivity burdens, photon spectrum after single scattering in a spherical tissue medium, and least-squares analysis of time-dependent gamma pulse-height spectra with adjustment for baseline and gain discrepancies are discussed. The least-squares program PARANA-GANCOM is included. (C.E.S.)

9732 IMPROVED NEUTRON DECAY SPECTROMETER. Yang, T. L.; Parkinson, T. F. (Univ. of Florida, Gainesville). Nucl. Sci. Eng., 35: 104-12(Jan. 1969).

The neutron decay spectrometer depends on the spectral analysis of the proton-electron pairs that originate from neutron decay. A spectrometer has been constructed which, compared to the prototype instrument, provides for increased collection efficiency, improved energy analysis, and reduced background. The resolving power, $\Delta E/E$, was measured over the neutron energy range $13 < E_n < 95$ keV, and a computer program was written for calculating the resolving power. Preliminary measurements of the total cross section of aluminum from 30 to 50 keV are described. (auth)

9733 LARGE SCINTILLATION COUNTER WITH GOOD ENERGY RESOLUTION. Gottschalk, B. (Northeastern Univ., Boston). Rev. Sci. Instrum., 40: 22-5(Jan. 1969).

A scintillation counter with a useful area 5.1 cm high by 61 cm long was constructed to stop protons up to 160 MeV energy. The energy resolution and the variation of output over the face of the counter have been measured using 160 MeV protons. The percentage peak width is 1.6% (full width at half-maximum) everywhere and the output varies, almost linearly, by 11.5% over the length of the counter and by about 1% over the height. (auth)

9734 A NEW MAGNETIC INSTRUMENT FOR ESCA. Nordberg, R.; Hedman, J.; Heden, P. F.; Nordling, C.; Siegbahn, K. Ark. Fys., 37: 489-508(1968). (In Swedish).

An instrument for ESCA is described in which momentum analysis of the electrons is performed with an iron free double-focusing magnetic spectrometer. The coil design combines good electron-optical properties with uncomplicated construction and ample space around the source and detector positions. The construction also allows for continuous control of external fields during the recording of spectra. An x-ray tube with high intensity stability, for soft x-rays, is used for excitation of the electron spectra. Spectra can be obtained from samples in the solid, liquid and gaseous phases. Detection is made either by channel electron multipliers or by a photographic emulsion and a track counting technique. (auth) (Sweden)

9735 CLAMP CELL FOR HIGH PRESSURE-LOW TEMPERATURE X-RAY AND MOESSBAUER RESONANCE STUDIES. Christoe, C. W.; Drickamer, H. G. (Univ. of Illinois, Urbana). Contract AT(11-1)-1198. Rev. Sci. Instrum., 40: 169-70(Jan. 1969).

A cell for x-ray and Mössbauer resonance studies at high pressure and low temperature is described. The pressure is generated between two Bridgman anvils with flats 0.203 cm in diameter. The pistons make a slip fit in the cell. The body contains an inlet hole and a 90° slot for egress of x rays or γ rays. It can be pinned precisely in place in the x-ray spectrometer or Mössbauer apparatus by means of three equally spaced holes in the base. (W.H.K.)

9736 MEASUREMENT OF SPECTRA FROM X-RAY MACHINES. Peaple, L. H. J.; Burt, A. K. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Med. Biol., 14: 73-85(Jan. 1969).

A transportable spectrometer and collimating system was developed for the measurement of photon spectra from a variety of x-ray machines in different locations. The photon spectrum is required for the assessment of dose and radiographic effect in diagnostic radiography. The accuracy of calibration procedures using filtered x-ray beams is also improved if the spectrum produced is known precisely. The equipment can be set up and the measurement of a large range of operating conditions completed in about 8 hours. A computer program has been written to convert the observed pulse height distributions to photon spectra. The mean energy and width are given for a range of calibration spectra, and examples are shown of the spectra produced by the diagnostic machines. Some effects of tube current and potential waveform are discussed. (auth)

9737 CORRECTION FOR SCATTERING IN COSMIC-RAY MUON SPECTROMETERS. Aurela, A. M.; Torsti, J. (Univ. of Turku, Finland). Ann. Acad. Sci. Fenn., Ser. A VI, No. 290, 1-16(1968).

The method of stabilization of unstable spectrometer equations was applied to the scattering correction of a muon spectrum measured by means of a cosmic-ray spectrometer with a solid iron magnet. The spectrum obtained by requiring non-negativity and monotony of the differential spectrum in the range of the present analysis (6.89–316 GeV/c) was regarded as the final result of the experiment. This result reinforced the previous result, obtained by approximate correction methods, except in the region around 50 GeV/c, where the new spectrum was higher than the previous one by 10%. The present scattering-correction method should be applicable to all cosmic-ray muon spectrometers involving solid iron magnets. The advantages of the method are improvement in accuracy, possibility of calculating the confidence limits for the results, and objectivity and explicitness in the smoothing of statistical errors. The fact that the v'th derivative of the theoretical spectrum is, on certain assumptions, positive for even v and negative for odd v, warranted the testing of the present stabilization method by using these theoretical constraints for high derivatives. The method worked well up to the combination of constrained derivatives with v = 0, 1, . . . , 10 (v = 0 meaning the spectrum proper). Certain improvements made during this work in the basic computer program shortened the computing times by an estimated factor of 10. (auth)

9738 PRESSURE CHANGING MECHANISM OF 300-LITER BUBBLE CHAMBER. Aleksanyan, A. S.; Arutyunyan, N. Kh.; Bekker, B. I.; Veremeev, M. M.; Levonyan, E. Ts.; Pikhtelev, R. N. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 3: 75-8(1968). (In Russian).

The expansion device, the pneumatic valves and the hydrodynamic processes of the 300-liter bubble chamber are described. The chamber can operate in two regimes volume striction and pressure striction. The comparison between the experimental and theoretical values of hydrodynamic characteristics is given. (auth)

9739 SPECTRUM OF EVAPORATION NEUTRONS PRODUCED BY COSMIC RAYS IN LEAD. Aurela, A. M.; Hakala, H.; Vaehaekangas, P. (Univ. of Turku, Finland). Ann. Acad. Sci. Fenn., Ser. A VI, No. 294, 1-24(1968).

The energy spectra of evaporation neutrons produced by cosmic rays in lead layers of different thicknesses were investigated by means of a paraffin-BF_3 spectrometer. The results were consistent with theoretical results calculated according to Bertini's data of neutron evaporation due to incident nucleons with energies of 25 to 400 MeV. No effects of incident nucleons with energies above 400 MeV were found in the spectra, nor any effects of the pionization. Counting rates of groups of coherent neutrons were also measured. Regarding the detection of high-energy cosmic-ray nucleons by means of monitors, the present data indicate that the best efficiencies are achieved by choosing the following thicknesses for the component layers: lead target: 20 cm or more; paraffin moderator: 5 cm; and paraffin reflector: 5 cm or more. Application of a stabilized resolution correction to the spectrometer led to two-dimensional stabilizing constraints, which were cursorily considered. (auth)

9740 30 cm RADIUS SECTOR TYPE DOUBLE-FOCUSING BETA RAY SPECTROMETER. Akiba, Toshimitsu; Ohama, Taro (Mitsubishi Electric Corp., Omiya, Japan). Mitsubishi Denki Lab. Rep., 42: 1627-35(Dec. 1968). (In Japanese).

A spectrometer installed in Nagoya University is capable of analyzing β-rays up to 4 MeV. Including the measurement of $\beta-\gamma$ angular correlation, it is able to count the number of events with an automatic counter. After the manufacture, a fringing field at the incident section and distribution of a magnetic field in a radial direction were compensated, and, with a sector of 205° and a free space length of 33 cm at the source of β-rays, double focusing was realized. By the use of a source of β-rays of 2 mm × 20 mm ^{137}Cs, the maximum luminosity of 1.0% and the best resolution of 0.27% were obtained. This result is slightly inferior to the specification designed by the use of sharp cut-off approximation. However, an electron orbit analysis in a fringing field approximated by a straight line was obtained and applied to a corrected field; then a double focused point of about 205° and the maximum transmission factor of 1.1% were obtained to show results almost identical with measured values. In $\beta-\gamma$ coincidence, a resolving time of 0.6 μs was achieved with a ^{60}Co source. (NSA of Japan)

High Energy Physics Instrumentation

Refer also to abstract 9785.

9741 (BNL–12953) BUBBLE CHAMBER TECHNIQUE FOR PHOTOGRAPHING INTERACTIONS OF HIGH ENERGY PARTICLES. Sondericker, John H. (Brookhaven National Lab., Upton, N. Y.). Aug. 13, 1968. 19p. (CONF-681115-1). Dep. CFSTI.

From Conference on the Society of Motion Picture and Television Engineers, Washington, D. C.

A brief history and a description of the operation of bubble chambers are given. Also, the development of bubble chamber technology is discussed. (W.H.K.)

9742 (BNL–13012) USE OF FSD BUBBLE DENSITY MEASUREMENTS FOR THREE BNL BUBBLE CHAMBER GROUP 80-INCH CHAMBER EXPERIMENTS. Strand, R. C.; Crennell, D. J.; Ellis, W. E.; Skillicorn, I. O. (Brookhaven National Lab., Upton, N. Y.). Oct. 24, 1968. 8p. (CONF-681025-6). Dep. CFSTI.

From International Conference on Advanced Data Processing for Bubble and Spark Chambers, Argonne, Ill.

Accurate FSD bubble density measurements are regularly obtained from the BNL Bubble Chamber Group 35 mm Mark I and 70 mm Mark II digitizers. The resulting savings of manual effort and computer time in three recent experiments have been studied and are reported. Also the role of density measurements in bubble chamber experiments is reviewed, and the history of FSD density measurements at BNL is discussed. (auth)

9743 (UCRL–18528(Rev.)) COBWEB DATA REDUCTION SYSTEM. Albrecht, Herbert C.; Binnall, Eugene P.; Birge,

Robert W.; Myers, Myron H.; Weber, P. Wes (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 21, 1968. Contract W-7405-eng-48. 74p. Dep. CFSTI.

Cobweb is a computer-controlled data reduction system which consists of an IBM 7044 computer, a time-sharing program, two LRL-built electronic interfaces, improved automatic-tracking Franckenstein-type measuring machines, and scan tables with teletypes. The purpose of the system is to acquire data on-line in a rapid, reliable fashion from the scanning and measuring of bubble chamber film. The editing of data is done off-line on a CDC 6600 computer. The result is a large gain in measuring rate with few errors. (auth)

9744 (UCRL-18544) DAPR: VERTEX SEARCH AND TRACK MATCH. Hall, Dennis (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1968. Contract W-7405-eng-48. 8p. (CONF-681025-4). Dep. CFSTI.

From International Conference on Advanced Data Processing for Bubble and Spark Chambers, Argonne, Ill.

A brief description of the vertex finding and track matching procedures used by the DAPR program is given. Vertex searching is accomplished by finding in each view all clusters of tracks whose ends are near the common intersection point of their descriptive circles. These view-vertices are spatially matched to associate clusters in the three views. Tracks of spatially matched clusters are compared to produce for each track in space the list of corresponding image tracks in each view. The algorithms used stress speed of decision. The comparison between views is a powerful tool used to clean up ambiguities unresolvable in individual views. Experience in use has demonstrated the speed and validity of the procedures used. Some additional degree of sophistication in the decision logic gives great promise of achieving results fully as good as the most careful manual scanning procedures. (auth)

9745 (UCRL-18545) BUBBLE DENSITY MEASUREMENTS WITH HAZE. Borreani, Giovanni; Hall, Dennis; Shalz, Loren; Hanson, Phillip (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 28, 1968. Contract W-7405-eng-48. 24p. (CONF-681025-2). Dep. CFSTI.

From International Conference on Advanced Data Processing for Bubble and Spark Chambers, Argonne, Ill.

Bubble density measurements with the HAZE computer program are described to resolve the mass identification of events which are kinematically ambiguous and to establish the correct mass of the charged particles in events for which two or more neutral particles are produced. (W.H.K.)

9746 (UCRL-18548) FSD HARDWARE MONITORING. Shalz, Loren (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 28, 1968. Contract W-7405-eng-48. 4p. (CONF-681025-5). Dep. CFSTI.

From International Conference on Advanced Data Processing for Bubble and Spark Chambers, Argonne, Ill.

Increased usage of the FSD by DAPR makes it more imperative that reliable, economical and efficient means of monitoring hardware performance are used. Unlike in HAZE, there is no human guidance against which current measuring performance is compared. The output from the digital and track center detection logic and the maintenance of calibration (relating normal and orthogonal mode measurements) are most fittingly monitored by the control computer. A brief description of the programs which monitor these features is presented. (auth)

9747 RECONSTRUCTION OF FIDUCIAL MARKS AND CAMERAS UTILIZING SIMULTANEOUSLY ALL THE PHOTOGRAPHS AVAILABLE. Negri, Pietro (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Rev. Sci. Instrum., 40: 148-54(Jan. 1969).

A program is described to calculate a posteriori the coordinates of a set of points photographed by n cameras, together with the positions and orientations of the cameras, also not known a priori for bubble chamber particle track analysis. The coordinates of the cameras are obtained by a unique fit, requiring the points measured on the pictures to be images of true points, existing somewhere in space. The coordinates of the points photographed are then easily obtained. (auth)

9748 KINEMATICAL IDENTIFICATION OF BUBBLE CHAMBER EVENTS. Fett, E. (Univ. of Bergen). pp 33-78 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

Scanning criteria, efficiency, and bias are first discussed. The general evaluation procedure and program used for analysis of the kinematic parameters of an event are presented. Two programs are used for most of the necessary calculations--THRESH and GRIND. (L.B.S.)

9749 SPIRAL SCANNING SYSTEM EMPLOYING ROTART AND RECIPROCATING MIRRORS FOR AUTOMATIC DATA MEASURING PROJECTORS. Toby, Fred L. (to United States Atomic Energy Commission). U. S. Patent 3,421,010. Jan. 7, 1969.

An optical system for scanning bubble-chamber photographs is described which, by virtue of a spiral scanning pattern, is particularly adapted to study of star-type events. A scanning head includes two mirrors arranged in periscope-like fashion to view a projected image of the photograph. A first large mirror of the periscope includes an entire segment of a circular area to be spirally scanned while a second mirror, much smaller than the first and the image area of said segment, views the reflected image from the first mirror. The second mirror is translatable along its own axis of reflection whereby it scans a path along the radius of said segment; rotating the periscope about the second axis of reflection in combination with a simultaneous outward directed translation of the second mirror thereby produces a spiral scanning path. (AEC)

9750 NaI(Tl) TOTAL ABSORPTION DETECTOR FOR ELECTRONS AND γ-RAYS AT GeV ENERGIES. Hofstadter, R.; Hughes, E. B.; Lakin, W. L.; Sick, I. (Stanford Univ., Calif.). Nature (London), 221: 228-30(Jan. 18, 1969).

A total absorption NaI(Tl) detector can be used to define the energy of an incident electron, or γ-ray, to a precision of 1 to 2 per cent in the range of 4 to 14 GeV. (auth)

Radiation Dosimeters

Refer also to abstract 10432.

9751 (COO-1105-116) STABILITY OF THE INCREASED SENSITIVITY OF LiF AS A FUNCTION OF TEMPERATURE. Wilson, C. R.; DeWerd, L. A.; Cameron, J. R. (Wisconsin Univ., Madison). [nd]. 8p. Dep. CFSTI.

A study was made of the amount of increased sensitivity of LiF (TLD-100) as a function of annealing time at various temperatures after a sensitizing exposure of 30 kR. The inactivation energy of the center responsible for the increased sensitivity was determined. (W.H.K.)

9752 (IDO-12064) FIELD EXPERIENCE WITH THERMOLUMINESCENT DOSIMETERS. Cusimano, John P.; Cipperley, Foster V.; Culley, John C. (Idaho Operations Office (AEC), Idaho Falls. Health Services Lab.). Sept. 1967. 11p. (CONF-670976-1). Dep. CFSTI.

From Conference on Radiations Dosimetry Based on Solid State Phenomena, Brussels, Belgium.

A routine system of personnel dosimetry utilizing the phenomena of thermoluminescence which has been developed at the National Reactor Testing Station is described. The new routine dosimetry system utilizes two lithium fluoride-teflon disc dosimeters held in a plastic dosimeter retainer that is the same size and held in a plastic dosimeter retainer that is the same size and shape as a standard film packet placed in the National Reactor Testing Station dosimetry badge. The field experience using the new system since its application in November 1966 is presented. (auth)

9753 (MLM-1570) LATENT IMAGE FADING IN PERSONNEL NEUTRON MONITORING FILM EXPOSED TO A MODERATED $^{238}PuO_2$ SOURCE. Arnett, E. N. (Mound Lab., Miamisburg, Ohio). Jan. 10, 1969. Contract AT(33-1)-Gen-53. 7p. Dep. CFSTI.

Latent image fading in neutron monitoring film was investigated for two weeks. One hundred and twenty pieces of neutron film were packaged in film badges and exposed to a moderated $^{238}PuO_2$ source at various time intervals. The daily exposure data indicated that there was 16% fading of neutron tracks after one week and 30% fading of neutron tracks after two weeks. Also, the weekly exposure data indicated that films receiving equal exposure for one week and developed on the second day of the following week had 17% fading of neutron tracks. Similarly, films receiving equal exposure for two consecutive weeks and developed on the second day of the third week had 30% fading of neutron tracks. The one- and two-week exposures approximate the radiation exposure which could be received by personnel exposed to neutron radiation in a $^{238}PuO_2$ process area. The combined results of latent image fading studies indicated that fading in neutron monitoring film cannot be accurately predicted on the basis of average energy alone. (auth)

9754 (NP-17514, pp 63-85) RADIATION PHYSICS LABORATORY. Youmans, H. D. (National Center for Radiological Health, Rockville, Md.).

Services provided by the Radiation Physics Laboratory consist of dosimetry and irradiation of biological specimens, maintenance of a central tracer-level radioisotope counting facility, and fabrication of nuclear and biomedical laboratory instrumentation. Thermoluminescent dosimetry is used with tissue equivalent

animal phantoms in designing irradiations. Rotary chambers for exposing rodents to x radiation are described. A number of electronic circuits were developed for detecting and measuring particular radiations or emissions. Investigations were conducted on spectra and percentage depth dose of x radiation emitted by a color television receiver. Studies on x-ray epilation in the treatment of tinea capitis included dosimetric investigations, morphological and biochemical investigations on brains of dogs, and lipid analyses of brains and rat mammary neoplasms. (H.L.W.)

9755 (AE-339) SILICON DIODE DOSIMETER FOR FAST NEUTRONS. Svansson, L.; Swedberg, P.; Widell, C.-O.; Wik, M. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Nov. 1968. 42p. Dep.

The change of the current-voltage characteristics of a small silicon diode is used as a measure of fast neutron dose in the Fast Neutron Dosimeter 5422. This change is permanent and therefore it is possible to integrate doses over a long period of time. Doses from some rad up to 1000 rad can be measured and the information stored is not destroyed during readout. The present investigation was made to establish the possibilities of the dosimeter for practical application and to study the variations of important parameters as a function of the production process. In particular the following parameters were studied: Dose sensitivity, energy dependence, fading effect, temperature influence and maximum measurable dose. In general one might conclude that the dosimeter 5422 well fulfills requirements usually specified for a dosimeter for field service. Temperature influence and fading effect are of little practical importance within the recommended range of measurement. (auth)

9756 (TRG-Report-619) USE OF SMALL ISOTHERMAL CALORIMETERS TO MEASURE THE RADIATION DOSE RATE IN CO_2/GRAPHITE RIGS. Standring, J. (United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Group). Aug. 30, 1963; Revised Jan. 2, 1964. 23p. (JNPC-MWP(G)/P-(63)88). Dep. CFSTI. UK 4s.

A study was made of the performance of two types of isothermal calorimeters designed to measure the radiation dose rate to graphite irradiated in CO_2/graphite rigs operated in materials testing reactors. The Mk III calorimeter is recommended, since it is not subject to the Compton interchange effect and can be electrically calibrated during use. Correct results may be obtained from Mk I calorimeters by use of a factor derived from calibration against a Mk III instrument. An axial survey was made in barrel 3 of the PLUTO 7V4 multi-barrel rig. Calculations indicated that about half the total dose rate in this rig arises from (n,γ) reactions in the pressure vessel. (auth) (UK)

9757 CALCULATOR FOR FRACTIONATED DOSES. Stewart, F. S. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Radiol., 41: 799-801(Oct. 1968).

Nomograms for the calculation of radiobiologically equivalent fractionated doses employing cell-survival curves are discussed. A time correction scale is described for the dose-response curves. (W.H.K.)

9758 ^{137}Cs TUBE (DOSIMETRY BY THE USE OF FLUOROGLASS RODS). Yasukochi, Hiroshi; Ihno, Yu (Tokyo Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1010-14(Oct. 1968). (In Japanese).

^{137}Cs tube has some advantages compared with ^{60}Co or ^{226}Ra sources. One of the advantages is its economical half life compared with other sources. Another advantage is its lower γ energy. This low γ energy has high efficiency for the protection of γ irradiation to the doctors and nurses and also for low volume dose to the patients compared with the tumor dose. The isodose curves of ^{137}Cs tube are measured by fluoroglass rods and demonstrated. Some comments on ^{137}Cs tube and fluoroglass dosimeter are also suggested. Two disadvantages of the ^{137}Cs tube are also added, one is leakage of activities from the tube and the other is the nonuniformity of the distribution of radioactivity in the tube, but these disadvantages may be improved with further trials. (auth) (NSA of Japan)

9759 DETERMINATION OF THE ABSORBED ENERGY OF RADIATION IN EXPERIMENT. Ermakov, I. A. Med. Radiol., 13: 58-61(Dec. 1968). (In Russian).

The calculation results of the constant chamber are given in terms of RADs per esu for different end-point energies of radiation used in radiological practice. The calculations are made for the end-point energy of 4.3 MeV according to L. V. Spencer and P. H. Attix's theory. The results of these calculations may be used in instances when there are no dosimeters directly calibrated in RADs. (auth)

9760 THERMOLUMINESCENCE OF LiF: A STATISTICAL ANALYSIS OF THE INFLUENCE OF PRE-ANNEALING ON THE PRECISION OF MEASUREMENT. Martensson, Bengt K. A. (Univ. of Lund, Sweden). Phys. Med. Biol., 14: 119-30(Jan. 1969).

The standard deviation of the signals recorded from thermoluminescent LiF as a function of the thermal treatment before irradiation (pre-annealing) was investigated. It is shown that for pre-annealing temperatures higher than -50°C the standard deviation increases with increasing pre-annealing temperature and pre-annealing time. A consequence of this is that in pre-annealing high temperatures should be used for periods as short as possible. If the thermal treatment during the readout (a few seconds at approximately 300°C) is the only high temperature treatment of the dosemeter between repeated irradiations, a standard deviation of 0.22% in the measured signals can be obtained. Different factors contributing to the standard deviation are analyzed, and a sensitive method for quantitative comparison between different readout instruments is given. (auth)

9761 THERMOLUMINESCENCE OF LiF: DEPENDENCE OF THERMAL HISTORY. Carlsson, Carl A. (Univ. of Lund, Sweden). Phys. Med. Biol., 14: 107-18(Jan. 1969).

The influence of thermal history on the yield of thermoluminescence was investigated for thermoluminescent LiF. Dosemeters (mostly LiF-Teflon) were stored at various temperatures for various times (pre-annealing) prior to irradiation and readout. Temperatures as high as 300°C may give the LiF-crystal a state of thermal equilibrium in a very short time (seconds), while the same equilibrium will not be reached for months at 80°C. For precision dosimetry it is suggested that pre-annealing at a high temperature should last only long enough to give thermal equilibrium and to empty all filled traps. Especially important is reproducibility of the cooling rate. With an appropriate heating circuit the demands of both preannealing and cooling rate can be satisfied with the readout heating. (auth)

9762 MEASUREMENT OF GRENZ RAYS. Trantner, F. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Phys. Med. Biol., 14: 149-50(Jan. 1969).

Some comments are made on the paper by Rollo, Katchis, and Dauer (Phys. Med. Biol. 13: 79 (1968)) entitled "A calorimetric method for the measurement of grenz rays," together with a reply from Rollo. (UK)

9763 SILVER-ACTIVATED LITHIUM BORATE GLASSES AS RADIOPHOTOLUMINESCENCE DOSIMETERS WITH LOW ENERGY DEPENDENCE. Becker, K.; Cheka, J. S. (Oak Ridge National Lab., Tenn.). Health Phys., 16: 125-33(Feb. 1969).

A radiophotoluminescent silver-activated glass based on the (Li_2O,B_2O_3) system instead of the usual metaphosphate matrix was studied. By reduction of the amount of silver activator, glasses with an energy dependence comparable to LiF (sensitivity variation within ±10 to 30% between 10 keV and several MeV) were prepared. Their weathering resistance was improved by additions of BeO. Maximum radiophotoluminescence (RPL) was developed by a heat treatment. More unusual dosimetric properties of such glasses are good stability even at high temperatures (up to 300-350°C), and a remarkable difference between the RPL and the absorption spectra obtained by thermal neutron and gamma radiation. The neutron induced RPL centers are also less stable than the gamma radiation induced centers. RPL and absorption spectra, as well as some other properties of these glasses, were studied in comparison with a conventional metaphosphate glass. (auth)

9764 CALIBRATION OF A 520 Ci ^{60}Co SOURCE. Rab Molla, M. A.; Abdullah, S. A.; Karim, F. (Atomic Energy Centre, Dacca, Pakistan). Health Phys., 16: 135-43(Feb. 1969).

A nominal 500 Ci ^{60}Co source was calibrated by Fricke (ferrous-ferric sulfate) chemical dosimetry and thimble chamber methods. The source consisted of a cylindrical pencil of metallic cobalt of 15.2 cm active length and 0.95 cm diameter, contained in a source flask which was housed in a 5 ft thick concrete room. The dose rates at various distances from the center of the source at seven horizontal planes were determined experimentally using both the methods. Appropriate equations were developed for the corresponding theoretical dose rates. All necessary corrections were made both for measured and calculated dose rates. Isodose curves were plotted using experimental values of dose rates obtained by Fricke method. The variation between the measured dose rate by the two experimental methods was less than 10%. In general it was observed that the measured dose rates were higher than the corresponding calculated values. This discrepancy was possibly due to scattering contribution from the ceiling, the floor and the four walls of the source room, which was not considered in the calculation. A detailed discussion of errors is given. (auth)

9765 THE APPLICATION OF PHOSPHOR-TEFLON THERMOLUMINESCENT DOSIMETERS TO THE MEASUREMENT OF

THE DOSE-RATE FROM RADIOACTIVE JEWELRY. Jones, Douglas (Con-Rad Labs., Isotopes, Inc., Cambridge, Mass.); Bjarngard, Bengt; Simon, Norman; Harley, John. Brit. J. Radiol., 41: 944-6(Dec. 1968).

The experimental technique described has made possible the measurements of the dose-rate to the finger from contaminated gold rings. The dose-rate to the basal layer of the skin of the finger from such rings can be as high as 60 rads/day. The dose-rate to the finger bone is of much less clinical significance, being about 10 mrads/day. (auth)

9766 CALIBRATION OF MONITORING FILMS FOR THE DOSIMETRY OF GAMMA RAYS BY MEANS OF LOW-ACTIVITY ^{226}Ra- OR ^{137}Cs-SOURCES IN A SHIELDED TRANSPORTABLE FACILITY. Paic, V. (Univ. of Zagreb). Int. J. Appl. Radiat. Isotop., 20: 11-21(Jan. 1969).

When persons are irradiated by x or gamma rays the accurate evaluation of the exposure by means of film dosimetry depends greatly upon the establishment of correct density-exposure calibration curves. The delicate procedure of calibration of film badges is made easy by the use of a shielded and transportable facility which employs either a ^{226}Ra- or a ^{137}Cs-calibration source, both sources being of low activity. The facility comprises a stand for nine film badges at fixed places, permitting exposures from 50 to 1500 mR in about 11 hr with the ^{226}Ra-source and in about 9 hr with the ^{137}Cs-source. The density-exposure curves obtained under scatter-free conditions were compared to those obtained in the facility. This comparison showed that the scattered radiation, due essentially to the lead shield around the source, is almost completely absorbed by a Sn filter (1 mm Sn for the ^{226}Ra-source, 0.1 mm Sn for the ^{137}Cs-source) covering one part of the film badge on both sides. The density produced under the Sn filter for a given exposure in the facility was higher by 10 per cent than that produced under the Sn filter by the same exposure delivered under scatter-free conditions of irradiation. Thus, when the exposure of a film badge worn by a person is interpreted by comparison with a calibration film irradiated in the facility, the deduced exposure is about 10 per cent lower than when the film badge is interpreted by comparison with a calibration film irradiated under scatter-free conditions. If correction factors are applied with the described calibration facility, it is possible to obtain results comparable to those obtained under scatter-free conditions. The log D = f(log X) curves and equations, as well as the correction factors, make it possible to dispense with the scatter-free calibration. (auth)

9767 A CODE OF PRACTICE FOR THE DOSIMETRY OF 2 TO 35 MV X-RAY AND ^{137}Cs AND ^{60}Co GAMMA-RAY BEAMS. Phys. Med. Biol., 14: 1-8(Jan. 1969).

The Code presented is an extension of that published previously (Hospital Physicists' Association, 1964). The main change is that there are added numerical data which extend the upper limit of application of the Code from 8 MeV to 35 MeV. The Code recommends a procedure and quotes numerical data which allow an ionization chamber, having an exposure calibration factor at one quality in the megavoltage range (i.e., 2 MeV x-rays or ^{60}Co γ-rays), to be used to determine the absorbed dose in rads at a point in water irradiated by x-rays generated at voltages in the range 2 MeV to 35 MeV or by ^{137}Cs or ^{60}Co γ-rays. (auth)

9768 THERMOLUMINESCENT TISSUE EQUIVALENT DOSIMETER. Distenfeld, C. H. (to United States Atomic Energy Commission). U. S. Patent 3,420,999. Jan. 7, 1969.

A dosimeter system is described in which gamma ray sensitive and neutron sensitive integrating thermoluminescent materials are shielded by and spaced from polyethylene to provide radiation equivalent man monitoring of mixed field radiation flux. Also, means are provided for distinguishing between thermal and high energy gamma rays. (AEC)

9769 IMPROVEMENTS IN OR RELATING TO THERMO-LUMINESCENT RADIATION DOSIMETERS. (to Isotopes Inc.). British Patent 1,140,028. Jan. 15, 1969. Priority date Jan. 13, 1966, United States.

The design of a lithium fluoride thermoluminescent dosimeter is described. (B.G.D.)

9770 THERMOLUMINESCENCE DOSIMETER (TLD). 1. THERMOLUMINESCENCE OF CALCIUM SULFATE PHOSPHORS ACTIVATED BY RARE EARTH. Kitamura, Saburo; Yamashita, Tadaoki (Matsushita Electric Industry Co., Ltd., Japan). Nat. Tech. Rep. (Matsushita Elec. Ind. Co., Osaka), 14: 397-402 (Dec. 1968). (In Japanese).

$CaSO_4$ crystals activated by rare earth elements were found to be free from the serious disadvantage of rapid fading in $CaSO_4$: Mn and yet retain the outstanding property of high sensitivity of $CaSO_4$: Mn, the most sensitive thermoluminescence dosimeter available at present. Among many kinds of phosphors tested, $CaSO_4$: Dy and $CaSO_4$: Tm showed the highest sensitivity with essentially a single glow peak at about 220°C. Emission spectrum of $CaSO_4$: Dy has two main peaks at 480 and 570 mμ, and $CaSO_4$: Tm consists of a main sharp peak at 450 mμ. The dosimetric characteristics of $CaSO_4$: Dy and $CaSO_4$: Tm are excellent: (1) little fading (5 ~ 8% per 6 months), (2) minimum detectable exposure is lower than 0.5 mR with standard deviation of ±20%, (3) dose response is linear up to 3×10^3 R, (4) tribothermoluminescence is very low (about 30th of that in LiF), and (5) constant thermoluminescence efficiency for more than 100 times of irradiation after repeated heating to erase previous dose. (NSA of Japan)

9771 ^{7}Li PHOSPHATE GLASS DETECTOR FOR EXPOSURE MEASUREMENTS IN MIXED NEUTRON–GAMMA RAY RADIATION FIELDS. Kerr, G. D.; Cheka, J. S. (Oak Ridge National Lab., Tenn.). Health Phys., 16: 231-2(Feb. 1969).

Comparisons were made between a depleted lithium phosphate glass and a standard glass with normal Li content, the latter having been found oversensitive to thermal neutrons in mixed neutron-gamma fields because of its high Li content. The depleted glass had the composition 49.8% $Al(PO_3)_3$, 44.2% $LiPO_3$, and 6% $AgPO_3$, whereas the standard glass contained 45% $Al(PO_3)_3$, 45% $LiPO_3$, 7% $AgPO_3$, and 3% B_2O_3. The photon energy dependence was found to be the same for both glasses, the maximum sensitivity for both types occurring at 50 keV. The thermal neutron responses were investigated at the Health Physics Research Reactor, using cadmium difference methods to separate the thermal neutron and gamma responses. The fast neutron responses were also investigated, using 14 MeV neutrons, and found to be small. It was concluded that if no mechanism is provided for subtracting or suppressing thermal neutron response the depleted glass was superior. (UK)

9772 ISOTOPIC EFFECT IN LITHIUM FLUORIDE THERMO-LUMINESCENT DOSIMETERS. Attix, F. H. (Naval Research Lab., Washington, D. C.). Phys. Med. Biol., 14: 147-8(Jan. 1969).

It is pointed out that the mass energy-absorption coefficient and the mass stopping power of a material depend on its isotopic composition, and this effect is discussed for LiF, ^{6}LiF, and ^{7}LiF, in which it is significantly large. Data are tabulated for the LiF phosphors TLD 100, 600 and 700. (UK)

9773 HIGH DOSE-LEVEL GLASS DOSIMETERS WITH LOW DEPENDENCE ON ENERGY. Cheka, J. S.; Becker, K. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 6: 162-75(Feb. 1969).

Glass dosimeters with low dependence on energy (less than ±20% between <10 keV and several MeV) have been made by activating lithium borates (Li_2O, x B_2O_3, x = 2 – 4) with small amounts (≤0.5%) of silver. The radiation induced absorption spectrum between 250 and 400 nm is more complex than in a commercial Ag-activated phosphate glass. Several peaks undergo a buildup prior to fading. At and above room temperature, the optical absorption, in particular for peaks below 300 nm, is considerably more stable than in the phosphate glass; (in one borate glass, for example, the absorption at 278 nm is constant within ±12% for 10 hr at 200°C). The absorption spectrum after thermal neutron radiation is different from the gamma radiation induced spectrum. The density is a linear function of exposure. (auth)

9774 IMPROVEMENTS IN OR RELATING TO THERMO-LUMINESCENT DOSIMETERS. (to Societe Anonyme, Mfg. Belge de Lampes et de Materiel Electronique, MBLE). British Patent 1,140,972. Jan. 22, 1969. Priority date Sept. 16, 1965, Belgium.

The fabrication of air-tight tubular glass containers for personnel thermoluminescent dosimeters is described. A wire heating element is included in the tube and connected to metal end caps to facilitate rapid readout. (W.H.K.)

9775 A THERMO-LUMINESCENCE TYPE RADIATION DOSIMETER. Yamashita, Tadsoki; Sakai, Kunio; Nada, Naohiro; Kitamura, Saburo (to Matsushita Electric Industrial Co. Ltd.). British Patent 1,139,377. Jan. 8, 1969. Filed Feb. 28, 1967.

In the thermoluminescent radiation dosimeter described the main material is calcium sulfate and the impurity ions are manganese and at least one of lead, nickel, cobalt, zinc, cadmium, lithium, beryllium, sodium, thorium, zirconium, rhenium and tungsten. By adding two kinds of impurity ions into the calcium sulfate the qualities of high sensitivity and high retention of radiation energy are claimed for the dosimeter. In one combination the calcium sulfate contains 0.05 to 0.5% by molecule weight of lead and 1 to 5% by molecule weight of manganese. Details are given of a manufacturing process involving heating a concentrated sulfuric acid solution containing calcium sulfate, manganese ions and at least one of the ions listed above, and crystallizing out cal-

cium sulfate in which the impurity ions have been segregated. Details are also given for the further treatment and molding of the crystal or powder of calcium sulfate disposed in fluoroethylene polymers and containing the impurity ions for incorporation in the dosimeter. Modifications necessary for a neutron sensitive dosimeter are stated; this involves the use of lithium or boron compounds and is adapted for measuring both ionizing radiation and neutron dose. (UK)

Radiometric Instruments

Refer also to abstract 9554.

9776 (AERE-R-5324) A RADIOMETRIC METHOD OF CONTINUOUSLY MEASURING THE ^{14}C CONCENTRATION IN CO/CO_2 MIXTURES. Munnoch, W. C. T.; Williams, D. (Atomic Energy Research Establishment, Harwell (England)). July 1968. 28p. Dep. CFSTI. UK 6s. 0d.

A ^{14}C tracer was used as an aid in studying the combined effects of irradiation and high temperature on graphite in a $CO-CO_2$ atmosphere. A method was required for continuously measuring this nuclide in the presence of other beta emitters. The problem is discussed and a successful technique is described. Details are given of energy discriminating and total-counting gas flow-cell scintillators and the associated electronic assemblies developed in the course of the work. (auth) (UK)

9777 APPARATUS FOR THE DETERMINATION OF OPACITY TO RADIATION PER UNIT OF THICKNESS OF OBJECTS. Evans, Hilton B. (to Marathon Oil Co.). U. S. Patent 3,414,725. Dec. 3, 1968. Filed Dec. 21, 1964.

The present invention comprises a radiation measuring device for determining opacity to radiation per unit of thickness of objects which may vary in thickness comprising in combination, a method for projecting a relatively narrow beam of radiation through the objects, method for measuring the intensity of the radiation passing through the objects, method for measuring the thickness of the objects at the points through which the radiation passes, method for compiling the outputs from the radiation detector and the thickness measuring device to directly indicate a variable which is dependent on the opacity to radiation per unit thickness of the object. Such determinations of unit opacity to radiation are particularly useful in the evaluation of geological specimens including those obtained by core drilling. (U. S. Pat. Gazette)

9778 LEAK DETECTION IN HIGH PRESSURE GAS SYSTEM. Spetzler, Hartmut; Schreiber, Edward; Newbigging, David (California Inst. of Tech., Pasadena). Rev. Sci. Instrum., 40: 179(Jan. 1969).

The use of krypton-85 for detecting leaks in high pressure gas systems is briefly discussed. (W.H.K.)

9779 MODIFICATION OF THE PORE SIZE DISTRIBUTION OF ARTIFICIAL GRAPHITES DENSIFIED BY CRACKING OF NATURAL GAS. STUDY BY MEANS OF A NEW γ ABSORPTION POROSIMETER. Bochirol, L.; Ortega, M.; Teoule, R. (CEN, Grenoble, France). Carbon, 6: 649-60(Oct. 1968). (In French).

A brief description is given of a new mercury porosimeter which uses γ-beam absorption. This apparatus allows measurements of local heterogeneities in pore size distribution. It was used to study the changes in pore size distribution after deposition of a pyrocarbon inside the pores of conventional nuclear graphites. The deposits were obtained by thermal decomposition of natural gas under normal pressure and ~1000°C. The influence of main parameters such as the gas flow, hydrogen content, and initial pore size distribution was studied. Such modification of pore size distribution appears to be of interest in the reduction of the radiolytic corrosion of graphites in CO_2. (auth)

9780 NEUTRONIC METHOD FOR THE MEASUREMENTS OF MOISTURE IN SURFACE SOILS. Moutonnet, P. (CEN, Cadarache, France). Int. J. Appl. Radiat. Isotop., 20: 23-7(Jan. 1969). (In French).

A fast neutron source placed in the superficial layers of a damp soil produces at the surface a thermal flux which can be measured with boron detectors. An experimental demonstration of the relationships between the flux and the volumetric moisture content for different source depths is described. It is also shown that the new measurement method proposed is well adapted to the heterogeneous water content distribution of surface soils. (auth)

9781 IMPROVEMENTS IN OR RELATING TO RADIATION RESPONSIVE DEVICES. Johnston, James Stewart (to Rosemount Engineering Co., Ltd.). British Patent 1,137,475. Dec. 18, 1968. Filed Jan. 13, 1966.

A radiation responsive device is described comprising a transparent or translucent fibre formed of a material which will fluoresce on exposure to radiation, means for controlling the exposure of the fibre to radiation, and a photocell responsive to the light due to fluorescence which is transmitted along the fibre. Forms of the device, and in particular the masking arrangements for controlling exposure, are described which are useful in determining the position of a radiated beam or the position of a movable member across a radiation source. Applications include digitisers, since output information can be provided in digital form representative of the position of a beam or the position of a movable member. The device can also be used for detecting the level of a liquid. (UK)

9782 LEVEL MEASUREMENT IN THE PROCESS OF GLASS PRODUCTION. Kobayashi, Kaneo Otomeshon, 13: No. 8, 27-31 (Aug. 1968). (In Japanese).

Gamma-ray level meters have been used in Koa Glass Co. one year for the measurement of the level in a feeder to a bottle-making machine. Compared with other (automatic) instruments used, the level meter has proved to be accurate and highly stable. The ^{60}Co gamma-ray source and its detector are placed on each side of the feeder to a bottle-making machine, and are connected to a series of the necessary other instruments. The need for γ-ray level meters, the principles of the γ-ray level meter, radioisotopes and the control area, setting of the source and detector, setting of electronic circuits and recorders, and the feeder and the entire operation are described. (NSA of Japan)

9783 METHOD AND APPARATUS FOR X-RAY FLUORESCENCE GAUGING OF A HIGHER ATOMIC NUMBER SELECTED ELEMENT IN A COATING ON A BASE. Hill, Robert C. (to Minnesota Mining and Mfg. Co.). U. S. Patent 3,417,243. Dec. 17, 1968. Filed Oct. 28, 1965.

A method and apparatus for x-ray fluorescence gaging of a selected element in a coating having an atomic number higher than the atomic number of any other element in a coating and base is described. The nondispersive x-ray fluorescence gage shown herein irradiates a localized area of a coating on the base with an x-ray beam having an excitation potential sufficient to excite the coating element to emit fluorescent radiation at its characteristic wavelengths together with background radiation and backscattered x-ray beam radiation. A single passive-filter is used having a predetermined thickness and x-ray absorption wavelength which is slightly shorter than at least one of the characteristic wavelengths of the fluorescent radiation of the selected element for selectively transmitting all of the radiation. A detector is positioned relative to the filter for receiving the selectively transmitted fluorescent radiation and for producing an output signal which is substantially proportional to the intensity of the fluorescent radiation intensity of the coating element. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 9553, 9567, 9592, 9595, 10905, 11199, 11200, 11251, and 11252.

9784 (AERE-R-5815) AN ADVANCED MODULAR SYSTEM OF ELECTRONIC EQUIPMENT FOR ON-LINE COMPUTER APPLICATIONS. Bisby, H. (Atomic Energy Research Establishment, Harwell (England)). Aug. 1968. 24p. Dep. CFSTI. UK 4s. 6d.

Representatives from major nuclear laboratories in Europe have collaborated, under the title of the ESONE Committee, in defining a standard physical form and other basic features for a new modular unit system of electronic instrumentation. The design of this system anticipates the inevitable future prominence of integrated circuit components. It further takes into account the trend, in scientific work, towards the real-time association of transducers with computers or other data processors for the collection, display and analysis of measurement data and for the purpose of control. The design principles of the system are presented and an interpretation given of the role which equipments designed to the new standard could play. The Harwell 7000 Series of equipment, also described, conforms to this new system. (auth) (UK)

9785 (BNL-13045) DATA TERMINAL NETWORK WITH ACCESS TO A LARGE COMPUTER COMPLEX. Culwick, B. B.; Glazer, E.; Hirst, D. V.; Meehan, T. C. (Brookhaven National Lab., Upton, N. Y.). Oct. 24, 1968. 11p. (CONF-681025-3). Dep. CFSTI.

From International Conference on Advanced Data Processing for Bubble and Spark Chambers, Argonne, Ill.

The Bubble Chamber Group at Brookhaven has constructed a system called a Data Terminal Network in collaboration with the Instrumentation and Applied Mathematics division of the labora-

tory. The design objective of this network is to provide members of the Bubble Chamber Group with a convenient means of access to the laboratory's central computer, a dual CDC 6600 with Extended Core Storage. In addition to access to the central computer, remote terminals are serviced to some extent by a satellite computer which handles the scheduling of resources. Remote terminals consist of a teletype, a relatively powerful CRT display, and a track-ball which serves the pointing function on the CRT screen. Development of the system is described. (auth)

9786 (BNL-13092) APPARATUS FOR MEASURING THE DIFFUSION OF IMPURITIES IN SOLIDS. Munkelwitz, H. R. (Brookhaven National Lab., Upton, N. Y.). Nov. 1968. 6p. (CONF-690402-1). Dep. CFSTI.

For Presentation at 157th National American Chemical Society Meeting, Minneapolis, Minn.

An apparatus developed at Brookhaven National Laboratory for the continuous measurement of volatile and semivolatile impurity atom transport rates in solids is described. This method was successfully used to measure the diffusion of fission-product iodine in spherical specimens of uranium monocarbide subsequent to irradiation and is readily adaptable to a wide variety of transport studies. (W.H.K.)

9787 (BNWL-SA-1938) APPLICATION OF A SMALL DIGITAL COMPUTER TO THE CONTROL OF A MASS SPECTROMETER. Lagergren, C. R.; Stoffels, J. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1, 1968. Contract AT(45-1)-1830. 10p. (CONF-681113-1). Dep. CFSTI.

From Conference on Chemistry and Spectroscopy, San Francisco, Calif.

A small digital computer system for controlling a mass spectrometer is described. Examples of operation of the mass spectrometer under computer control such as adjustment or testing, data collection and processing, and data storage and retrieval are given. (W.H.K.)

9788 (CEA-R-3565) BLOCKING OF PHOTOMULTIPLIER TUBES. Andrivet, Jacques (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Oct. 1968. 16p. (In French). Dep.

Development of a very simple apparatus having a single transistor is described. The grain is reduced by a factor of 1.5 to 3×10^2 for the photomultipliers XP 1002, and of 10^3 to 10^4 for the photomultipliers 56 AVP and TVP. Blocking can be achieved in 40 nsec if necessary (using a TRS-350 transistor), and the time required to return to the initial gain can be no longer than 40 nsec with a TRS-200, for blockings of several micro-seconds for example. 1000 μsec and above can be obtained with switching times which are longer but which can be less than 150 nsec if needs be. An outside insulated supply can be avoided if the recurrence is low. A standard pulse generator is used for triggering. There is no other electronic equipment, and the device can be fitted easily into the space of the voltage divider. (auth)

9789 (KAPL-M-6921) SUPRFOX: A PROGRAM AND SUBROUTINES FOR PROCESSING X-RAY PHOTOMETER DATA AND DATA SIMILARLY ARRAYED INTO ROWS AND COLUMNS. Covert, A. S. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 10, 1968. Contract W-31-109-eng-52. 31p. Dep. CFSTI.

A guide is provided for using SUPRFOX, a FORTRAN IV program for processing x-ray photometer data. The purpose of the program is to develop measures of process capability. Input and output are described. The output, which is printed and graphic, contains descriptive statistics and analyses of variance. Examples of the quantitative interpretation of the analysis of variance are given. (auth)

9790 (N-66-39688) RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE. Fifth Annual Progress Report. Levin, Gilbert V.; Horowitz, Norman H. (Hazleton Labs., Falls Church, Va.). Oct. 1966. Contract NASr-10. 116p. (NASA-CR-78991). CFSTI.

Instrumentation and field testing of the Mark IV model of the Gulliver radioisotopic biochemical probe for extraterrestrial life are described. Despite the good results of the field test, the model demonstrated a sensitivity exceeding that of the current instrument by approximately 2½ orders of magnitude. An account is given for this loss of sensitivity, which is a trade-off for various advantages in reliability, simplicity, and weight-saving aspects of the instrument. A statistical summary for the five-yr Gulliver program is presented. Results obtained from tests of all types, except those in which mechanical failure or contamination of the controls occurred, are included. Factors influencing the instrumentation such as size, mass, sterilization, and launch, space and planetary environments are considered. The design and fabrication of the mechanical and electronic components is also discussed. (STAR)

9791 (NYO-3406-12) X-RAY IMAGE INTENSIFICATION. Technical Report No. 8. Reynolds, Geo. T. (Princeton Univ., N. J. Elementary Particles Lab.). Nov. 25, 1968. Contract AT(30-1)-3406. 25p. Dep. CFSTI.

Some initial results are presented of efforts to adapt conventional image intensifiers to the studies of low-angle x-ray diffraction patterns, as an outgrowth of previous work in the imaging of radioactive tracer deposits of very low specific activity. (B.G.D.)

9792 (RCN-98, pp 101-30) QUANTISATION, SAMPLING FREQUENCY, AND DISPERSION WITH CORRELATION MEASUREMENTS. Veltman, B. [P. Th.] (Technische Hogeschool, Delft (Netherlands)).

A two-state characterization of random signals has many advantages with statistical computations for describing the properties of the underlying stochastic process. The common operations as multiplication, integration and time shift are easily performed with on-off signals. Of special interest is the computation of correlation functions. With a large class of stochastic processes the two-state characterization is simply obtained by using the polarity of the signals compared to their mean values. For other processes a modulation technique is explained which permits an interpretation of the polarity measurements in terms of signal quantization. The modulation method uses the property of forming a cumulative distribution by adding an independent signal with a rectangular distribution (convolution of both distributions). It is illustrated that the variances due to finite observation time are hardly affected with these methods and can be compensated by an increase in sampling frequency of the signals. The implements for the construction of an on-line correlator are obvious. The simple time-compression and Fourier-transformation are other attractive features. (15 references) (auth)

9793 (RCN-98, pp 131-44) CORRELATOR AS AN INTEGRATED PART OF A MEASURING INSTRUMENT. Veltman, B. P. Th. (Technische Hogeschool, Delft (Netherlands)).

An on-line special-purpose computer for the measurement of cross-correlation functions and cross-spectral density functions is discussed. (B.G.D.)

9794 (TID-24888) PROGRESS REPORT [ON NUCLEAR PHYSICS], TASK B. (Rice Univ., Houston, Tex.). 1968. Contract AT(40-1)-1316. 18p. Dep. CFSTI.

Research and development in instrumentation and techniques, gaseous and liquid electronics, beam-foil spectroscopy, and theoretical studies are outlined. Also, personnel and personnel changes are given and publications in 1968 are listed. (W.H.K.)

9795 IMPROVEMENTS RELATING TO COLLIMATORS. Openshaw, Ian Kay (to Associated Electrical Industries, Ltd.). British Patent 1,136,255. Dec. 11, 1968. Filed Mar. 28, 1966.

A collimator for x-rays and gamma radiation is described consisting of an array of spaced parallel screens having aligned slit apertures of progressively varying width, together with magnets between at least some of the screens on opposite sides of the beam path, arranged to produce a magnetic field across the beam path to deflect electrons laterally so that they are intercepted by the screens. A particular application for the device is in x-ray analyzers. (UK)

9796 IMPROVEMENTS RELATING TO TR CELLS. Knox, Robert McLaren (to Ferranti, Ltd.). British Patent 1,132,069. Oct. 30, 1968. Filed Dec. 24, 1964.

In gas discharge switching devices known as TR cells it is usually desirable to keep the gas partially ionized and so reduce the breakdown voltage to a value well below that which would damage the mixer crystal or other apparatus which the cell is required to protect. An electrode known as a keep-alive electrode is sometimes used for this purpose, but it has disadvantages. To overcome to some extent these disadvantages a method is described whereby partial ionization within the TR cell is maintained by means of a gaseous radioactive material. The material is preferably an α- or β-emitter of energy too low to pass the confines of the cell. Tritium and radioactive krypton are suggested. (UK)

9797 HIGHLY STABLE HIGH-RATE DISCRIMINATOR FOR GENERAL USE IN NUCLEAR COUNTING APPLICATIONS. Rudnick, S. J.; English, J. J.; Howard, R. H. (Argonne National Lab., Ill.). Rev. Sci. Instrum., 40: 9-15(Jan. 1969).

A new pulse amplitude discriminator, especially suitable for counting experiments, has been developed. Ten units were built and tested, and all of the threshold temperature coefficients are in the range −0.03 to +0.12 mV per °C. At very high rates the threshold is stable and the output pulse width and the dead time change negligibly. Since the unit incorporates a number of convenient features, including provision for automatic dead-time correction, it is an extremely versatile instrument. (auth)

9798 X-RAY TUBE (30 kV AT 60 A) (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1801).

22 drawings.

The design and fabrication of a 30 kV at 60 A x-ray tube used in studying the density of gases produced by the detonation of high explosives are described. The tube operates in the area between the very high current but short duration flash x-ray tubes and the low-current, long-time-interval standard tubes. The cathodes have run well at 1800°C brightness yielding 25 to 28 A/cm^2 at 370 mA/W thermal efficiency for 120 $\mu\mu$sec pulses. The pulser is monitored through the Be window. (For details see TID-4100 Suppl. 49). (F.S.)

9799 TEMPERATURE MEASUREMENT IN NUCLEAR MAGNETIC RESONANCE WITH A SPINNING THERMISTOR. Van Geet, Anthony L. (State Univ. of New York, Buffalo). Rev. Sci. Instrum., 40: 177-8(Jan. 1969).

A method has been developed to measure the temperature inside the NMR sample tube directly with a thermistor. Moreover, the tube remains closed with a pressure cap, and it is not even necessary to stop the spinning to measure the temperature. A direct temperature readout on a meter is obtained throughout the experiment. The accuracy is ±1°C or better between −50 and +150°C. (auth)

9800 HIGH PRESSURE ENDOR CAVITY. Doyle, W. T.; Dutton, T. F.; Liu, H. P. (Dartmouth Coll., Hanover, N. H.). Rev. Sci. Instrum., 40: 171-2(Jan. 1969).

A TE_{011} mode cylindrical cavity is described for high-pressure electron−nuclear double resonance (ENDOR) measurements. The system has been used to measure the shifts in F center hyperfine interactions with pressure from 0 to 3 kilobars in a number of alkali halides at room temperature with satisfactory signal-to-noise ratio. (W.H.K.)

9801 PRECISION THERMOMETER FOR THE REGION 10 TO 40K. Gill, D. (Univ. of California, Santa Barbara); Kaplan, N.; Thompson, R.; Jaccarino, V.; Guggenheim, H. J. Rev. Sci. Instrum., 40: 109-113(Jan. 1969).

A low temperature thermometer based on the temperature dependence of the $\nu_F(T)$ of the ^{19}F NMR frequency in antiferromagnetic MnF_2 has been successfully operated in the 10−40 K temperature region. Novel features include the use of a MnF_2 crystal with a sharp ^{19}F NMR line as the temperature sensitive element in a solid state frequency-locking autodyne circuit that operates while completely submerged in liquid H_2 or He. In the present design the circuit-sample combination takes the form of a compact probe. With this device temperature readings which are reproducible to $\pm 10^{-4}$ K at 20 K have been obtained. Various applications for precision thermometry in the 10−40 K range using the device are proposed. (auth)

9802 SiO_2(QUARTZ), MgO, PbF_2, AND Bi AS LOW-PASS NEUTRON VELOCITY FILTERS. Holmryd, Sten; Connor, Donald (Argonne National Lab., Ill.). Rev. Sci. Instrum., 40: 49-56 (Jan. 1969).

We have measured the transmission of monochromatic slow neutrons over the wavelength range 1−5 Å for monocrystalline and polycrystalline samples of SiO_2(quartz), MgO, PbF_2, and Bi at 83 K and 300 K. These materials were selected as apparently suitable for use as neutron low-pass velocity filters; SiO_2 and Bi have already been used in this manner at several laboratories. Single crystals of MgO cooled to 83 K are remarkably transparent to thermal neutrons; more than 70% of the incident 2 Å neutrons are transmitted by a 15 cm sample whose transmission for 1−2 MeV neutrons is about 0.01. SiO_2 is nearly as transparent, in agreement with several earlier measurements by other workers. A comparison of our measurements on Bi with other reported work shows that neutron transmission is low and quite variable from sample to sample for neutron wavelengths in the range 1−2 Å but fairly high for all samples at wavelengths >4 Å (~50% for a 15 cm sample). For the latter wavelength range, we find slowly cooled Bi casting, in which large grains have developed, to be about as transparent as (nominally) monocrystalline samples. A single crystal of PbF_2 exhibited higher transmission in the range 1−3.5 Å than did any Bi sample. The theoretical basis for the neutron filtering action of crystalline materials is briefly discussed. (auth)

9803 FLYBACK SYSTEM FOR A CONSTANT VELOCITY MOESSBAUER DRIVE. Chase, Robert L. (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instrum., 40: 85-8(Jan. 1969).

A flyback system is described for use with a Mössbauer drive transducer of the coupled loudspeaker type operating at constant programmed velocity. A flyback control waveform is generated which quickly returns the transducer to its starting position and reestablishes the programmed velocity without exciting mechanical resonances. In addition, the range over which the velocity is maintained constant and counting is permitted is automatically held constant, independent of the programmed velocity, to eliminate systematic errors that would result from a correlation between average position and velocity. (auth)

9804 AN ION EJECTION TECHNIQUE FOR THE STUDY OF ION-MOLECULE REACTIONS WITH ION CYCLOTRON RESONANCE SPECTROSCOPY. Beauchamp, J. L.; Armstrong, John T. (California Inst. of Tech., Pasadena, Calif.). Rev. Sci. Instrum., 40: 123-8(Jan. 1969).

A novel technique involving a straightforward modification of an ion cyclotron resonance spectrometer has been developed which utilizes the excitation of the characteristic oscillatory motion of the ions, due to the trapping field, for ejecting ions from the cyclotron resonance cell. By pulsing the rf ejection field and referencing the detection system to the pulsing frequency, a spectrum of ions whose number density is modulated by the pulsed ejection field is obtained. This is directly applicable in studying ion−molecule reactions for the determination of product ion distributions, even when other processes, such as direct ionization or concurrent ion−molecule reactions, contribute to product ions of interest. (auth)

9805 CHARACTERISTICS OF COMPOSITE CARBON RESISTORS USED FOR MEASURING ACCELERATOR TERMINAL VOLTAGES. Stevenson, F. R.; Gauntner, D. J. (National Aeronautics and Space Administration, Cleveland). Rev. Sci. Instrum., 40: 140-4(Jan. 1969).

A voltage divider board composed of 1152, 22 MΩ composite carbon resistors used to measure the terminal voltage of a 3 MeV Dynamitron was investigated. The board was calibrated in situ using the ^9Be and D photoneutron threshold reactions and a magnetic analyzer. The present calibration of the divider board which was made after over 5 years of extensive accelerator usage agrees within 2% with the original factory calibration. The linear temperature coefficient of resistance was measured to be $+(0.85 \pm 0.10) \times 10^{-3}$/°C in the range 25 to 35°C. The divider board resistance decreased linearly with voltage (-1.1×10^{-5}%/V) up to 2 MeV which corresponds to 1750 V on each resistor. The results show that composite carbon resistors and the techniques described can be applied with confidence to the measurement of high voltage. (auth)

9806 MODULATION TRANSFER FUNCTIONS OF X-RAY FOCAL SPOTS. Rao, U. V. Gopala; Bates, Lloyd M. (Johns Hopkins School of Hygiene and Public Health, Baltimore). Phys. Med. Biol., 14: 93-106(Jan. 1969).

A method is presented for the experimental determination of the modulation transfer functions of x-ray focal spots. The apparatus described is sufficiently flexible to permit the measurement of these functions under various conditions of x-ray tube operation and at various positions and directions in a plane perpendicular to the direction of the x-ray beam. The results of measurements on four tubes used in the United States are discussed. Data on two tubes are given in detail with the theoretical functions expected from a focal spot having uniform emission and the dimensions specified by the manufacturer. Phase transfer functions are calculated from the measurements and their significance in radiography is discussed. (auth)

9807 THE X-RAY SPECTRUM FROM A 2 MVp ALTERNATING POTENTIAL GENERATOR. Saylor, W. L. (Walter Reed General Hospital, Washington D. C.). Phys. Med. Biol., 14: 87-91(Jan. 1969).

The x-ray spectrum from a 2 MVp resonant transformer generator was determined by the method of attenuation analysis. Spectra are presented for the conditions without an added filter and for an added filter of 5 mm lead. The experimental spectrum is compared with spectra produced by constant potential generators at 1.4 and 2.0 MV and measured by different means. The experimental spectrum is also compared with the Kulenkampff−Kramers model for thick target bremsstrahlung from monoenergetic electron beams, and is seen to resemble closely that predicted by the model for a constant potential generator excited at 1.8 MV. (auth)

9808 METHOD AND DEVICE FOR MEASURING THE GAS CONTENT OF A FLOWING TWO-PHASE MIXTURE. Chedeville, Christian; Lions, Noel; Rosse, Marcel (to Commissariat a l'Energie Atomique). British Patent 1,138,433. Jan. 1, 1969. Priority date Feb. 22, 1966, France.

A method is described for measuring the gas content of a flowing two-phase mixture consisting of a liquid in which gas is present in the state of bubbles, and is also concerned with a device for the practical application of this method. The method and device are primarily although not exclusively intended for the determination

of small quantities of inert gas such as argon, for example, which are contained in liquid coolants such as liquid sodium which are utilized in some types of nuclear reactor. The method according to the invention makes use of the variations in the velocity of sound in the two-phase mixture as a function of the gas content. (B.G.D.)

9809 UNDERWATER X-RAY APPARATUS. Sayag, Claude; Nauche, Roger; Menetrier, Jacques; Perot, Georges (to EURATOM). British Patent 1,138,483. Jan. 1, 1969. Priority date June 1, 1965, Belgium.

An x-ray apparatus for the irradiation of articles or elements underwater, including radioactive articles or elements. The apparatus can be used in a swimming pool reactor for making x-ray examinations of irradiated articles, such as capsules, loops, and fuel cells. (B.G.D.)

9810 THE TECHNIQUE OF SCANNOGRAM CONTRASTING ON THE COMPUTER "URAL-3". Serebryanyi, E. G.; Tarasov, V. M.; Krimer, B. M. (Inst. of Medical Radiobiology, Moscow). Med. Radiol., 13: 61-6(Dec. 1968). (In Russian).

In the practice of radioisotope diagnosis the use of methods of contour scanning of the organ studied is not always distinct. The proposed method of contrasting images with the use of computers is effective, when statistical series of information distribution in zones of the organ and surrounding tissues markedly overcross each other, and the methods of calculating the number of lines and dampening of signals with a low counting rate make it impossible to single out an image of the organ. (auth)

9811 GRAPHITE PRISM FOR APPLIED NEUTRON PHYSICAL MEASUREMENTS. Deme, Sandor; Makra, Zsigmond; Veres, Zoltan. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 16: 357-65(1968). (In Hungarian).

A graphite prism, with the dimensions 180 cm by 180 cm by 240 cm, is described. The prism will be used for applied neutron physical measurements, such as the calibration of detectors and the determination of the yield of neutron sources. By varying the location of the neutron source and/or the detector, the spectrum as well as the flux of neutrons can be varied in a wide range. The flux can be evaluated from the activation of foils, or when a source of known yield is used, by calculation. The prism is applicable for the intercomparison of various neutron sources. The prism will be used primarily for the calibration of neutron survey equipment covering a wide range of energies. (auth)

9812 A SET OF X-RAY FILTERS FOR A DOSIMETER CALIBRATION FACILITY. Burt, A. K. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Med. Biol., 14: 131-2(Jan. 1969).

Details are given of filter arrangements used with the constant potential x-ray set at the Berkeley Nuclear Laboratory (UK); the set is employed for the evaluation and calibration, at known photon energies, of large numbers of health physics survey instruments. The filters cover the energy range 30 to 200 keV, and comprise Pb, Sn, Cu, and Al. Details of some measurements with the system are included. (UK)

9813 DEVICE FOR DETECTING A NUCLEAR-FUEL FAILURE. Tone, Hirohito (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-20229. Aug. 30, 1968. Filed Dec. 14, 1964.

The device proposed has a high detection efficiency; and the detection is certain. It consists of the following: column(I), packed with molecular sieve 13X, which is capable of flowing separately at certain time intervals a mixture of Ar and Kr, and Xe, with Q gas as the carrier; column (II), packed with either molecular sieve 5A or activated charcoal, which is capable of flowing separately at certain time intervals Ar and Kr, this column being installed in parallel with the column (I); the source of the gaseous substance to be measured, and the Q-gas source, both connected to the columns; the detectors to measure the portions of gas from the columns; and the corresponding recorders. (NSA of Japan)

9814 IMPROVEMENTS IN OR RELATING TO ELECTRIC DISCHARGE DEVICES. (to M-O Valve Co., Ltd.). British Patent 1,137,673. Dec. 27, 1968. Filed Dec. 30, 1964.

In electric discharge devices where a high density plasma may be produced close to the surface of a solid electrically conductive member there is a tendency for an electric arc to be produced at the surface when it is at a negative potential with respect to the plasma (e.g., the anode of a high power rectifying device immediately following the conducting cycle; or the metal wall of a toroidal discharge chamber in a thermonuclear experiment during the discharge period). It is stated that such unwanted arcs are to some extent due to the presence of particles of impurity material of very high resistivity in the surface member, for example alumina in molybdenum. These particles may act as small capacitances which charge up when ions are attracted to the member from the plasma until a small local discharge occurs creating conditions for an unwanted arc to form. To reduce the tendency for these arcs to occur each impurity should have a resistivity of less than 10^3 ohm centimeters, at least when the member is at its normal operating temperature. Details are given of one application: to a high power, mercury cathode rectifier. (UK)

9815 PERIOD METER WITH ZENER DIODES TO CONTROL THE TIME CONSTANT. Kuwabara, Jun (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-20230. Aug. 30, 1968. Filed Mar. 19, 1966.

A voltage-dividing circuit, consisting of zener diodes and resistances, is connected to the output terminal of a logarithmic amplifier, and it is fed back to the input of the amplifier from a dividing point via a capacity. In this way, the smoothing constant is controlled so that, at the time of a low input current, the noise effective value in the output terminal of the period meter is made constant without depending on an input current, to improve the response. (NSA of Japan)

9816 MASS SPECTROMETER FOR BORON TRIFLUORIDE ISOTOPIC ANALYSIS (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). (CAPE-1786).

36 drawings.

Modifications are described for a General Electric, six-inch radius isotope mass spectrometer for automatic operation with a molecular beam source assembly. The assembly provides condensing temperatures sufficiently low to minimize the diffusion of boron trifluoride gas, and to control the memory level when this gas is analyzed. (For details see TID-4100 Suppl. 49) (See also 22: 48816) (F.S.)

9817 MODIFICATION OF A PICKER MAGNASCANNER TO ELIMINATE SCALLOPING. Dean, P. M.; Sear, R. (London Hospital, Eng.). Phys. Med. Biol., 14: 143-6(Jan. 1969).

The lateral displacement of successive scan lines in opposite directions, due to the operation of the ratemeter time constant, produces the familiar scalloping effect, and it is pointed out that the time constant limitation artificially imposed by this effect is more stringent by at least an order of magnitude than the inherent limitation necessary to avoid serious amplitude and spatial distortion. It is possible to eliminate the effect of scalloping by various techniques. An inexpensive modification to a Picker Magnascanner, permitting satisfactory uni-directional scanning, and overcoming the scalloping difficulty is described. Details are given of circuit and other modifications, and application to brain scanning is briefly described. (UK)

9818 EXPERIENCE WITH A SIMPLE MOISTURE GAUGE FOR EMBEDMENT IN CONCRETE. Lee, C. R.; Bryden-Smith, D. W. (Building Research Station, Watford, Eng.). pp 635-9 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Use of a moisture gauge based on electrical resistance and suitable for embedment in concrete is described. The gauge has concentric electrodes and an autoclaved mortar element. The interpretation of the resistance changes of the gauge includes allowances for aging of the surrounding concrete and for temperature changes. Experience with such gauges embedded in concrete reactor shields at four power stations, and in the massive concrete structures of a proton synchrotron (Nimrod) over 9 years, has shown that the gauges can provide a most useful indication of the changing patterns of drying in the concrete. (auth) (UK)

9819 QUANTITATIVE ASSESSMENT OF THE CHARACTERISTICS OF A GAMMA CAMERA WITHOUT THE USE OF A MULTICHANNEL ANALYSER. Constable, A. R. (London Univ.); Hill, D. W. Phys. Med. Biol., 14: 139-42(Jan. 1969).

The satisfactory operation of an Anger type gamma camera necessitates periodic measurements of such characteristics as sensitivity, resolution, linearity, and field uniformity, and a complete series of tests may be performed with the aid of a multichannel analyzer. Where a suitable multichannel analyzer, however, is not available adequate measurements can be made with a system comprising two analyzers, a coincidence unit and a ratemeter/chart recorder. The use of such a system as an integral part of a gamma camera having a renography attachment is described, and comparison made with the use of a multi-channel analyzer. It was concluded that the method is capable of measuring camera characteristics with a reliability adequate for most purposes. (UK)

9820 GAMMA CAMERA WITH A SPARK CHAMBER. Miyazawa, Tatsuo (Tokyo Shibaura Electric Co., Ltd.). Radioisotopes (Tokyo), 17: 334-7(July 1968). (In Japanese).

Several devices are available for showing, in an image, the

distribution of radioisotopes in organs of the human body. As a unique one for the purposes, there is a method, employing a spark chamber with a gas discharge. The spark chamber is simple in construction and operation and variable in shape and size, with a high resolution. The characteristics etc. of the spark chamber are described. (NSA of Japan)

9821 MASS SPECTROMETERS. Alexandru, Gr. (Inst. of Nuclear Physics, Bucharest). Stud. Cercet. Fiz., 20: 779-89 (1968). (In Rumanian).

A new mass spectrometer allowing a simultaneous introduction and measurement of sample and referable standard is described. It can be used both for the detection of very small differences in isotopic composition of elements and in oil industry automatization. The residual background has no influence on the measurements. (auth)

9822 GAS CHROMATOGRAPHIC DETECTOR UTILIZING RADIOACTIVITY. Hartmann, Charles H. (to Varian Associates). U. S. Patent 3,417,238. Dec. 17, 1968. Filed Apr. 6, 1965.

A gas chromatographic detector is described in which the sample gas is ionized by metastable atoms of the carrier gas. An electric field strength in the range 2500 to 3800 volts per centimeter is maintained in the electrode gap. The high field strength increases the detector's sensitivity through a combination of avalanche excitation of the carrier gas atoms and acceleration of secondary electrons to energies sufficient to directly ionize sample gas atoms. Detector sensitivity is in the range 1 to 10 parts per billion of O_2, CO_2, and CO. (auth)

9823 ACOUSTIC TRANSDUCERS. White, John Bernard; tone, Alan Matthew; Lawson, Roy (to English Electric Co., Ltd.). British Patent 1,134,497. Nov. 27, 1968. Filed May 13, 1965.

A transducer is described suitable for detecting acoustic vibrations in a fluid. One suitable application is in a delivery duct leading from a blower for coolant gas in a nuclear reactor. The transducer consists of a body having a cylindrical cavity open at one end, the other end being closed by an integral wall in the form of a disc encircled by an integral annular membrane substantially thinner than the disc. The open end of the cavity is closed by a cover plate and a piezoelectric crystal is trapped in contact with the disc and a rigid encapsulating medium (e.g. an epoxy resin), the medium filling all free space between the crystal and the cover plate. An O-ring of rubber or similar material encircles the crystal to locate it radially in the cavity. (UK)

Radiation Effects on Instruments and Instrument Components

9824 STRUCTURE AND HEALING OF TRACKS FROM NUCLEAR FISSION FRAGMENTS IN SINGLE CRYSTALS OF LiF AND $CaCO_3$. Geguzin, Ya. E.; Vorob'eva, I. V.; Suslova, A. G.; Demyanov, L. D.; Selina, L. S. (Kharkov State Univ.). Dokl. Akad. Nauk SSSR, 182: 552-4(Sept. 21, 1968). (In Russian).

The kinetics of the healing of tracks generated in crystals by the spontaneous or induced fission of heavy nuclei depends on the crystal structure, i.e., the distribution of defects within the limits of the track. Investigation of this problem in the case of LiF and $CaCO_3$ crystals resulted in a new concept of the structure and the thermal stability of the tracks. The tracks in the LiF crystals were generated by the fragments of the ^{245}Cm nucleus at the rate of 10^4 tracks/cm^2 per hour of irradiation; the $CaCO_3$ preparation with a ^{235}U was exposed to a flux of 10^4 n/cm^2 in a thermal column. The tracks were developed by etching, using a saturated aqueous solution of $FeCl_3$ and formic acid for LiF and $CaCO_3$, respectively; the angles were determined interferometrically. An increased level of defect distribution was noted in certain portions of the crystals similar to those resulting from stress in mica. This specific distribution of defects near the tracks is noticed especially during the healing process in LiF single crystals. It is concluded that during high-temperature annealing, these crystals become ordered, i.e., the degree of defects with a given depth as a function of time decreases. (TTT)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 9360, 9361, 9731, 9790, 9910, 9929, 9962, 9964, 9969, 9976, 9978, 9986, 10015, 10017, 10039, 10045, 10048, 10050, 10060, 10072, 10073, 10083, 10088, 10092, 10106, 10111, 10123–10125, and 10154.

9825 (AEC-tr-6940, pp 47-51) EFFECT OF RADIOACTIVE SUBSTANCES ON THE EMBRYONIC DEVELOPMENT OF FISH. Ivanov, V. N. Translated from pp 185-90 of Voprosy Biookeanografii. Materialy II Mezhdunarodnogo Okeanograficheskogo Kongressa, 30 Maya–9 Iyunya 1966 g, Moscow, Naukova Dumka, Kiev, 1967.

Eggs of a number of species of Black Sea fish were incubated in solutions of ^{90}Sr and ^{90}Y with an activity of 10^{-7} to 10^{-9} Ci/l or ^{144}Ce solutions with an activity of 10^{-6} Ci/l. The effects of the radioactive environment on morphology and survival of larvae were measured. It was noted that mortality of the eggs increased with the increase of incubation temperature. The mitotic activity decreased and the number of chromosome aberrations increased as a function of radioactivity of the solutions. The uptake of ^{89}Sr, ^{90}Sr, ^{90}Y, ^{91}Y, ^{106}Ru, ^{137}Cs, ^{144}Ce, ^{59}Fe, and ^{35}S from seawater by growing fish eggs was measured. Radionuclides of Ce, Fe, and Y accumulated on the surface of the eggs, while radionuclides of Cs and Sr localized in the tissues of the embryos and the absorbed radiation dose increased with time. (C.H.)

9826 (AEC-tr-6940, pp 52-8) KINETIC PATTERNS OF THE BUILD-UP AND EXCHANGE OF RADIOACTIVE ISOTOPES IN SEA ALGAE. Barinov, G. V. Translated from pp 190-7 of Voprosy Biookeanografii. Materialy II Mezhdunarodnogo Okeanograficheskogo Kongressa, 30 Maya–9 Iyunya 1966 g, Moscow, Naukova Dumka, Kiev, 1967.

The kinetics of the build-up and exchange of radioisotopes by algae in sea water was investigated. Brown algae, Cystoseira barbara, and green algae, Ulva rigida, were maintained in solutions of ^{45}Ca and ^{89}Sr. The uptake and exchange of Ca and Sr in algae was found to be related to sorption and diffusion rather than enzymatic metabolism. Calcium exchange was approximately 7% in Ulva and 12% in Cystoseira while Sr exchange was close to 100% in Ulva and 37% in Cystoseira. The exchange between algae and seawater involved the entire element and was not limited to the radioactive isotopes. Variables affecting the uptake of radioisotopes by hydrobionts are discussed. (C.H.)

9827 (BNL-12784) SKIN ALLOGRAFT SURVIVAL IN LYMPHOCYTE DEPLETED CALVES. Chanana, A. D.; Cronkite, E. P.; Joel, D. D.; Schiffer, L. M. (Brookhaven National Lab., Upton, N. Y.). [1968]. 5p. Dep. CFSTI.

The small lymphocyte is considered to play an important role in allograft rejection. The effects of lymphocyte depletion induced by various procedures on the survival of skin allografts was studied in calves. Results showed that lymphocytopenia induced by extracorporeal irradiation of blood (ECIB) resulted in only slight prolongation of skin allograft survival; lymphocytopenia induced by thymectomy alone or thymectomy combined with ECIB did not increase the survival time of skin allografts over that obtained by ECIB alone. Imuran, even in small non-toxic doses, showed complementary effects when combined with ECIB on the prolongation of skin allograft survival. (C.H.)

9828 (CEA-R-3433) COLLECTION AND PROCESSING OF INFORMATION IN BIOLOGICAL KINETICS STUDIES WITH RADIOACTIVE TRACERS. Remy, Jacques; Lafuma, Jacques (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr. 1968. 25p. (In French). Dep.

An automatic method is described for the collection and treatment of information in biological kinetics experiments using radioactive tracers. The recordings are made without any time constant on magnetic tape. The information recorded is sampled by a 400 channel multiscale analyzer and transferred to punched cards. The digital analysis is done by an IBM computer. The method is illustrated by an example: the hepatic fixation of colloidal ^{198}Au in the pig. Its advantages and requirements are discussed. In the appendix, the FORTRAN language for two programs used in the examples is discussed. (auth)

9829 (CEA-R-3539) STUDIES ON THE TRANSFORMATION OF FIBRINOGEN TO FIBRIN. RADIATION EFFECTS. OBSERVATION BY ELECTRON MICROSCOPY. Marguerie de Rotrou, Gerard; Hollard, Daniel; Suscillon, Michel; Cuong, Michele; de Vitry, Florence (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sept. 1968. 22p. (In French). Dep.

Electron microscopy, thrombodynamography, and spectrophotometry were used to study the damage caused by x rays on the fibrinogen molecule and fibrin formation process. This process was highly disturbed by increasing doses of irradiation from 0 to 3.10^3 R. Electron microscopy observation showed the structure of the plug, formed by irradiated fibrinogen solution. A new model of the fibrinogen molecule is presented. (C.H.)

9830 (CEA-R-3623) IN VITRO FIXATION OF PLUTONIUM TO HUMAN TRANSFERRIN AND COMPETITION REACTION WITH FERRIC IONS. Massey, Pierre; Lafuma, Jacques (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Sept. 1968. 19p. (In French). Dep.

Plutonium was found to bind strongly to human transferrin, however a maximum capacity of absorption was observed. Presaturation of transferrin with iron resulted in a decrease of plutonium binding, but it still remained appreciable. It was also affected by pH as well as by the degree of ferric saturation of the transferrin. (auth)

9831 (NP-17514, pp 5-24) PHYSIOLOGY AND BIOPHYSICS LABORATORY. Shore, M. L. (National Center for Radiological Health, Rockville, Md.).

Studies were conducted on radioinduced harmful somatic mutations. Effects of radiation delivered both in utero and after birth were studied. Assessment of radiation damage was made from a study of radioinduced pathological conditions. Effects of x radiation on induced synthesis of tryptophan pyrrolase in adult rats were studied in order to test the hypothesis that radiation can interfere with the transcription of the DNA template in resting mammalian cells. Radiation did interfere with the DNA-directed mRNA-dependent induction of this enzyme, but not with its in vivo stabilization by tryptophan. Relative rates of tryptophan pyrrolase degradation were determined following the administration of hydrocortisone and tryptophan to intact rats. In vitro and in vivo studies were conducted on effects of radiation on protein synthesis in a cell-free system isolated from rat liver. Biochemical effects in rats irradiated in utero were investigated in order to determine whether the de novo enzyme synthesis at birth was dependent on new synthesis of DNA directed mRNA. Radiation effects on the structure of globular proteins in solution were studied using the technique of transient electric birefringence. Bovine pancreatic ribonuclease was used as the model protein. The influence of glucan on irradiated and nonirradiated mice was investigated. It was thought that toxicity would be decreased by grinding the glucan; therefore ground and unground glucan was used to determine effects of particle size on mice. The amount of glucan in the liver was independent of whether the glucan was ground or not; however, the stimulatory effects of glucan were significantly reduced by grinding. It was observed that increasing the glucan surface area by grinding caused a decrease in reticulo-endothelial activity. A technique for isolation of Kupffer cells from rat liver is described. (H.L.W.)

9832 (NP-17514, pp 25-46) RADIONUCLIDE TOXICOLOGY LABORATORY. Stara, J. F. (National Center for Radiological Health, Rockville, Md.).

Studies on radiostrontium metabolism and effects in cats during development and growth included: placental transfer of divalent cations; ^{85}Sr, ^{89}Sr, and ^{90}Sr kinetics in cats; influence of diet composition on skeletal deposition of strontium; ^{90}Sr dosimetry in skeletal tissues of cats; and investigation of strontium in tooth layers as an index of strontium skeletal burdens. Studies on radioiodine distribution in guinea pigs and felines included maternal-fetal relationship to ^{131}I in the guinea pig; distribution and teratogenic effects of ^{131}I in embryonic guinea pigs; chromatographic analysis of selected maternal and fetal guinea pig tissues for ^{131}I compounds; and radioiodine metabolism in felines. Radiopharmaceutical studies included: repressive action of alginates on strontium absorption in cats; localization of labeled tetracycline and fibrinogen in infarcts and tumors of mammals; and ^{99}Tc labeled albumin in felines. Studies on metabolism and assessment of heavy radionuclides included: dosimetry of ^{210}Pb and ^{210}Po in exposed populations; ^{137}Cs and natural radioactivity in the Alaskan food chain; and translocation of ^{210}Po from deposited ^{210}Pn in felines. Studies on tobacco and tobacco smoke revealed that ^{210}Pb, ^{210}Po, and ^{226}Ra were in equilibrium in tobacco; however, ^{210}Po contributed ten times as much activity as the other two isotopes to tobacco smoke. (H.L.W.)

9833 (NYO-910-69) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. PROPOSAL NO. 1. RADIATION STUDIES. 1. FREE RADICAL PRODUCTION IN BIOLOGICALLY SIGNIFICANT COMPOUNDS. 2. THEORETICAL INVESTIGATION OF ELECTRON LET SPECTRA AND DOSE RELATIONSHIP FOR IONIZING RADIATIONS. Progress Report, May 1, 1967–May 1, 1968. Laughlin, John S.; Pullman, Ira; Kessaris, Nikitas D. (Sloan-Kettering Inst. for Cancer Research, New York). Sept. 30, 1968. Contract AT-(30-1)-910. 6p. Dep. CFSTI.

ELECTRON BEAMS—dose absorbed in carbon and water, ratio of, to cavity chamber ionization at various depths
HYDROCARBONS—computer-based calculation of hyperfine coupling constants for biologically significant polycyclic
RADIATION—dose to biological materials in relation to LET spectra, ionizing, (T)
ULTRAVIOLET RADIATION—effects on production of free radicals in samples of 3-hydroxyxanthine, ESR studies of
X RADIATION—effects on spin transfer processes in nucleotides and ribosephosphate, ESR studies of protective effects of cysteamine against
—effects on apatite-calcified elastin, ESR studies of protective effects of cysteamine against (E.R.B.)

9834 (NYO-910-70) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. PROPOSAL NO. 2. 1. RADIATION MECHANISMS IN MAMMALIAN SYSTEMS. 2. CHEMICAL SENSITIZATION TO RADIATION LETHALITY. Progress Report, May 1, 1967–May 1, 1968. Laughlin, John S.; Kim, Jae Ho; Moroson, Harold; Djordjevic, Bozidar (Sloan-Kettering Inst. for Cancer Research, New York). Sept. 30, 1968. Contract AT(30-1)-910. 6p. Dep. CFSTI.

CELLS—radiosensitivity of tumor, in vitro and in vivo, effects of N-ethylmaleimide and oxygen content on
CELLS, CULTURED—synthesis of DNA in mammalian, role of early and late synthesized protein and RNA in
—radiation effects on synthesis of proteins and RNA in mammalian, x
—activity of deoxycytidine monophosphate deaminase in mammalian, effects of cell cycle on
—toxicity to metabolic inhibitors in mammalian, effects of cell phase on
—growth of mammalian, effects of inhibitors of DNA synthesis on unbalanced
—radiosensitivity of mammalian, effects of cell cycle and puromycinaminonucleoside on x
—radiosensitivity of mammalian, effects of inhibitors of DNA and protein synthesis on ionizing
CELLS, HeLa—radiation effects on, effects of oxygen content on high-energy pulsed electron and x
—growth of cultured, effects of asparaginase on (E.R.B.)

9835 (NYO-2265-14) A PROGRAM FOR THE STUDY OF TRANSPLANTATION OF TISSUES AND ORGANS, AND OF RELATED TOPICS IN SURGICAL RESEARCH. Technical Progress Report, June 16, 1967–June 15, 1968. Moore, Francis D. (Peter Bent Brigham Hospital, Boston, Mass.). June 15, 1968. Contract AT(30-1)-2265. 33p. Dep. CFSTI.

Progress is reported on studies relating to the transplantation of tissues in human patients and tracer studies on the metabolism of Br, K, tritium, and ^{51}Cr-erythrocytes in surgical patients. Data are summarized on clinical findings on a group of 110 patients that received kidney transplants. A modified immunosuppressive regime was developed that employed antilymphocyte globulin prepared in the horse using thoracic duct lymphocytes from the patient as antigen. (C.H.)

9836 (ORO-661, pp 16-18) PLACENTAL TRANSFER AND FETAL DEVELOPMENT. Wykoff, M. H.; Cragle, R. G.; Miller, J. K. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

The transfer of ^{85}Sr and ^{134}Cs across placental tissues to the fetus was studied in swine. Sixteen sows were given intraperitoneal injections of ^{85}Sr and ^{134}Cs on the day they were bred and the content of fission products in fetal membranes and fluids and in the fetus itself was measured in the very early stages of gestation. High concentrations of ^{85}Sr were found in chorionic fluid followed by amniotic fluid, fetal membranes, and other fetal tissues at the 42nd day of gestation. After 56 days, the time at which ossification begins, the major fetal site for ^{85}Sr was bone. Cesium-134 concentrations in fetal fluids and tissues were insignificant. (E.R.B.)

9837 (ORO-661, pp 47-9) PHYSIOLOGY. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

To determine whether unique substances are formed in irradiated animals, sheep were exposed to whole-body doses of 400 R of ^{60}Co γ rays. Following irradiation, urine samples were collected from each sheep from time 0 to 10 days postirradiation. Samples for each day were pooled, analyzed, and comparisons made with samples taken before irradiation. To date, five substances were found in urine samples from irradiated sheep that were not present in the urine of nonirradiated sheep. (E.R.B.)

9838 (ORO-661, pp 50-5) EARLY EFFECTS. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

Studies on the effects of γ radiation on chimeric cattle continue with little change in the nature of the data for percent survival or average survival time. The results of studies on the immunosuppressive effects of γ rays on co-twin tissue transplants and the success of the transplants in the co-twin chimeric cattle, led to the kidney transplant studies presently under way. The success of the kidney transplants in chimeric cattle, without the use of immunosuppressants, is discussed. (E.R.B.)

9839 (ORO-661, pp 61-76) NUTRITION. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

CALCIUM-45—absorption by small intestine of chickens following perfusion, effects of calcium and strontium content of diet on
—absorption by liver uterine mucosa of chickens,
IODINE-125—concentration in salivary glands of cattle following intravenous injection, effects of sodium thiocyanate on
IODINE-131—effects on iodine metabolism, lactation, and thyroid glands of cattle following single dose, β and γ
—content of milk following administration to cattle, effects of oral sodium thiocyanate and L-thyroxine on
SELENIUM-75—binding by reticulocytes in sheep and swine, mechanisms for
—incorporation into hemoglobin of sheep and swine, chromatographic analysis of
STRONTIUM-85—absorption by liver uterine mucosa of chickens
—absorption by small intestine of chickens, effects of calcium and strontium content of diet on (E.R.B.)

9840 (ORO-3295-4) THE RELATION OF X-RADIATION, GROWTH HORMONES, AND AGING ON POLYRIBOSOME FUNCTION IN REGENERATING RAT LIVER. Progress Report, October 1, 1967–September 30, 1968. Tipton, Samuel R. (Tennessee Univ., Knoxville. Dept. of Zoology and Entomology). Contract AT(40-1)-3295. 8p. Dep. CFSTI.

Results are reported from in vivo and in vitro studies on the effects of doses of x radiation ranging from 1,500 to 50,000 R on the function of ribosomes in regenerating liver of partially hepatectomized rats. The effects of age on radiosensitivity of polysomes and the effects of irradiation on the binding of labeled triiodothyronine by intracellular components of rats were studied. (C.H.)

9841 (ORO-3347-3) PHYSIOLOGICAL STUDIES ON CLOSTRIDIUM BOTULINUM, TYPE F. Progress Report, December 1, 1965–November 30, 1966. Walls, Nancy W. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract AT(40-1)-3347. 103p. Dep. CFSTI.

The effects of varying certain nutritional and physical conditions during growth of Clostridium botulinum type F cultures on the physiological activities, autolysis, sporulation, and toxin production were investigated. (C.H.)

9842 (UCLA-12-686) SEMIANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1968. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). Contract AT(04-1)-Gen-12. 84p. Dep. CFSTI.

Separate abstracts were prepared on five sections of this report. A list is included of 45 publications generated during the period covered by this report. (C.H.)

For abstracts of individual sections see: 9843, 9844, 9908, 9984, and 9985.

9843 (UCLA-12-686, pp 1-20) BIOCHEMISTRY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Studies on the metabolism of lipids are reported. Data are included on the fatty acid content of glial cells isolated from the white matter of brains of cattle; the role of phospholipids in iodine binding in rats; the effects of temperature on the biosynthesis of unsaturated fatty acids in Bacillus megaterium; the γ-radiolysis of saturated fatty acids; the metabolism of fatty acids in cultured cells from rat heart; the composition of liver oil of the basking shark (Cetorhinus maximus); and the origin of ingested wax found in the stomach of a rare African bird, Zenker's honey-guide (Melignomon zenkeri). (C.H.)

9844 (UCLA-12-686, pp 67-84) RADIOBIOLOGY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Applications of pulse radiolysis, ESR flow, and chromatographic techniques for studies of reactions of free radicals with nucleic acid constituents and sulfhydryl compounds in aqueous solutions are reported. An attempt was made to simulate the ESR spectra of irradiated nucleic acid compounds by computer techniques. Rates of decay and absorption spectra of transients produced by 10 MeV electron irradiation of aqueous solutions of 5-bromouracil were determined by pulse radiolysis. The effects of chloride ion on the radiolysis of pyrimidines, purines, nucleotides, and nucleosides were studied. Measurements were made of rate constants for the radiolysis of DNA in the presence and absence of chloride. Results of studies in mice indicated that large doses of cortisone inhibited the stimulation of erythrocyte production by erythropoietin. (C.H.)

9845 (UCRL-18216, pp 1-43) ANIMAL, PLANT, AND BACTERIAL BIOCHEMISTRY. (California Univ., Berkeley. Lawrence Radiation Lab.).

ANGIOSPERMIDAE — Papaves somniferum, biosynthesis of thebaine in, role of reticuline as precursor in
NICOTINE — biosynthesis in tobacco plants, tracer study of intermediates in
PHOTOSYNTHESIS — metabolic regulation of carbon reduction cycle in
RATS — problem solving and routine behavior in, effects of differential enriched or impoverished experiences on
— brain measurements in, effects of differential enriched or impoverished experiences on
— content of choline acetyltransferase in brain homogenates from, radiometric methods for determining
SCHIZOMYCOTA — Escherichia coli, metabolism of galactose, glucose, and lactose in, compartmentation of
THEBAINE — conversion to codeine in biosynthesis of morphine, identification of codeinone intermediate in
— synthesis from codeinone dimethyl ketal (E.R.B.)

9846 USE OF A NEW RADIOASSAY FOR TRYPTOPHAN OXYGENASE TO STUDY THE DEVELOPMENT OF THE ENZYME IN CHICK EMBRYOS. Peterkofsky, Beverly (National Cancer Inst., Bethesda, Md.). Arch. Biochem. Biophys., 128: 637-45 (Dec. 1968).

A method for the assay of tryptophan oxygenase was developed that is approximately ten times more sensitive than previous assays. Radioactive tryptophan labeled at the number 2 carbon atom of the ring is used as substrate. Following the sequential action of tryptophan oxygenase and excess formyl-L-kynurenine formylase, the ^{14}C is released as formic acid, that is then isolated by passage of the deproteinized incubation mixture through a cation-exchange column. This assay was used to study the accumulation of tryptophan oxygenase during chick embryogenesis. It was found that accumulation of the enzyme is not linearly related to growth of the embryo or liver tissue, and that there is a large increase in the rate of accumulation, relative to growth, after embryos have reached the age of approximately 11 days (2.5 to 3 g/embryo). This effect was also reflected in a twofold increase in the specific activity of the enzyme during the period from 8 to 13 days of development. (auth)

9847 A METHOD OF MEASURING VERY WEAK OPTICAL DENSITIES IN A LIVING CELL, UTILIZING MICRO-IRRADIATION BY LASERS. Lutz, Marc; Salet, Christian (Hopital de Bicetre, Val-de-Marne, France). Compt. Rend., Ser. D, 267: 1300-3 (Oct. 14, 1968). (In French).

By comparison with known models, the factor by which mitochondria of KB cells in culture concentrate oxidized Janus B Green with respect to the coloration bath was evaluated. It was also shown that in order to obtain a localized thermal effect with weak absorptions, there is an optimum irradiation duration. (tr-auth)

9848 THE INFLUENCE OF X RADIATION AND MUSTARD GAS ON METHIONINE-^{35}S INCORPORATION IN ERYTHROCYTES. Prokes, J.; Svoboda, V.; Hynie, I.; Proksova, M.; Kacl, K. (Charles Univ., Prague. Veterinary Research Centre, Prague). Neoplasma, 15: 393-8(1968).

X radiation and β,β'-dichlordiethylsulfide S-mustard will inhibit incorporation of administered methionine ^{35}S activity into erythrocytes in rats, both in vivo and in vitro. A portion of the processes responsible for that inhibitory effect is localized in erythrocytes. Inhibition does not manifest itself until after a period longer than 2 or 3 hours following administration of methionine; thus it is not a case of mere change in permeability of the erythrocyte membrane. (auth)

9849 METABOLISM AND TOXICITY OF PLUTONIUM. Maisin, J. R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). J. Belge Radiol., 51: 274-83(1968). (In French).

The problem of the toxicity and metabolism of plutonium is discussed and the main channels of penetration and elimination of this nuclide in the human body are reviewed. The consequences of a contamination by ^{239}Pu are then examined and the basic principles for the treatment of the contamination are stated. The problem of assessing the plutonium body burden is also dealt with. (auth)

9850 SOME RESIDUAL PHENOMENA OF ACUTE RADIATION DISEASE IN DOGS. Kerova, N. I.; Chebotar'ov, E. Yu.; Tolmachova, L. G. (Bogomoletz Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 358-67(May-June 1968). (In Ukrainian).

Two to three years after irradiation, the processes of hemopoiesis, nitrogen-albumin metabolism, and sugar-regulating functions of the liver returned to normal. Restoration of normal quantities of hemoglobin, erythrocytes, reticulocytes, and thrombocytes occurred within a period of three months. However, restoration of the normal leukocyte count required two to three years. Three months to three years were required for restoration of nitrogen-albumin metabolism. (H.L.W.)

9851 NEUTRON AUTORADIOGRAPHIC DETERMINATION OF ^{10}B CONCENTRATION AND DISTRIBUTION IN MAMMALIAN TISSUE. Fairchild, R. G.; Tonna, E. A.; Seibold, Clara T.; Straub, R. F. (Brookhaven National Lab., Upton, N. Y.). Radiat. Res., 36: 87-97(1968). (BNL-11912).

The application of a low-background neutron autoradiographic technique for determining ^{10}B concentration and intracellular distribution in mammalian tissue is described. Knowledge of ^{10}B concentration and distribution on a cellular level is necessary to evaluate the effects of irradiation when using the $^{10}B(n,\alpha)^7Li$ reaction in experimental therapeutic procedures. Conventional boron analysis is not capable of extracting this information. The use of freeze-dried tissues, dry-mounted on nuclear emulsion, makes the technique applicable to water-soluble compounds used in previous clinical trials, as well as to water-insoluble proteins. Absolute concentrations of ^{10}B in the form of sodium pentaborate were measured in mouse spleen, liver, kidney, muscle, tumor, and brain, 30 minutes after intraperitoneal injection, and compared to results from three other laboratories using conventional analysis. Boron concentrations similar to those used in previous clinical trials were evaluated to demonstrate the feasibility of the method. No intranuclear or extracellular concentration was observed; evidence is given to demonstrate the absence of leaching of the water-soluble compound. The method described will be useful in evaluating the newer boron compounds attached to proteins. The intracellular distribution of these compounds is of particular interest, since it is not clear that all proteins are capable of penetrating cell walls. (auth)

9852 IONIC DISTRIBUTION STUDIES IN HAEMOLYMPH FROM DIFFERENT PARTS OF PERIPLANETA AMERICANA BY RADIOACTIVE TRACERS. Lahiri, S. K.; Roy, A.; Banerjee, D.; Jamdar, S. C.; Basu, S. R.; Nag, B. D. (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Exp. Biol., 5: 27-8(1967).

The relative distributions of five major ions, Cl^-, Fe^{3+}, I^-, HPO_4^{2-}, and Na have been investigated in antennal and femoral hemolymph of P. americana using radioactive isotopes of the respective elements. Generally the antennal hemolymph was richer than femoral fluid in inorganic cation but poorer in anion. The concentration of the Na^+, Cl^-, I^-, HPO_4^{2-}, and Na^+ varied in the antennal and femoral hemolymph, whereas Fe^{3+} was the same in both. Antennal hemolymph was richer in I^- and Na^+ compared to femoral hemolymph but poorer in Cl^- and HPO_4^{2-}. Internal radiation had no effect on the relative ion distribution in the antennal and femoral hemolymph even when heavy doses (100 μC.) of the tracer isotopes were used. (10 references) (Indian Sci. Abstr.)

9853 RADIATION BIOLOGY. Casarett, Alison P. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1968. 378p. $9.25. (TID-24693).

Effects of ionizing radiation in biological systems at the molecular, cellular, organ, organism, and community level are covered in a general, unified manner. The book is fully illustrated. Descriptions and possible mechanisms of the acute radiation syndrome in mammals are given. The chapter on radiation dosimetry includes techniques commonly used for irradiating biological specimens. Certain aspects of applied radiation biology are discussed with regard to exposures to be expected and estimates of the probable effects on present and future generations from current medical, industrial, and military applications of ionizing radiation. Chapters are included on radiation physics, radiation chemistry, radiation genetics, differential cell sensitivity, and effects

of radiation on higher plants. Author and subject indexes are included. (H.L.W.)

9854 MOLECULAR MECHANISMS OF MUTATION. Carbera-Juarez, Emiliano (Instituto Politecnico Nacional, Mexico City). Ciencia (Mexico), 26: 7-24(Feb. 25, 1968). (In Spanish).

The mutagenic action of uv and visible light and of chemical agents was reviewed against a background of present knowledge of the structure and replication of DNA. Mutations produced in Trichophyton by uv irradiation occurred with maximum efficiency at a wavelength of 260 nm, corresponding to the absorption maxima of DNA and RNA. This correlation was noted in other biological systems and points strongly to the nucleic acids as the site of uv mutagenesis. Direct action of uv on nucleic acid constituents in solution demonstrated thymine dimerization, a reaction also evident under in vivo conditions of uv irradiation. Other compounds formed when thymine was irradiated in vitro included 5-hydroxymethyluracil, 5-formyluracil, 5-carboxyuracil, and uracil. Errors in replication of DNA when it or its constituents were exposed to uv irradiation were postulated. This then was reflected in synthesis of RNA and protein mediated by the altered DNA. Determination of the precise sites of DNA alterations that were the basis of mutations required precise sequential analysis of the DNA bases. (BBB)

9855 EFFECTS OF RADIATION ON ASSIMILATION OF ^{45}Ca IN RAT BONES. Tueller-Siegfried, Christine (Univ., Bern). Radiol. Clin. Biol., 37: 149-55(1968). (In German).

The turnover of ^{45}Ca in rats can be modified by x radiation when the calcium is situated on the surface of the hydroxyl apatite crystals of bone. When the mineral has already penetrated into the interior of the crystal, the metabolism can no longer be disturbed by the applied dose (2000 rad). The turnover disturbance showed its relation to time as well as in its relation to dose a different pattern of its curve than the disturbance of calcium uptake. It was concluded that the calcium uptake and the calcium turnover are caused by different mechanisms. (auth)

9856 RECOVERY IN THE MOUSE SPLEEN AFTER SUBLETHAL IRRADIATION. Petrov, R. V.; Koslov, V. A.; Seslavina, L. S. (Inst. of Biophysics, Moscow). Cell Tissue Kinet., 1: 369-75(Oct. 1968).

CBA and C57Bl mice were exposed to $LD_{50/30}$ doses of γ radiation and at intervals after irradiation the numbers of hemopoietic colony-forming units (CFU) and of antibody-producing cells in the spleen were determined. CFU repression was observed after transfer of non-irradiated cells to hybrid recipients. However, this repression did not appear until 60 days after irradiation of the donor. The recovery after irradiation of the capacity to inactivate CFUs in spleen cell mixtures was studied. The results suggested that cells that produce 19S antibody were different from those that were reactive against foreign cells. (auth)

9857 TRITIUM. Nyo, U Htin (Union of Burma Applied Research Inst., Rangoon). Union Burma J. Sci. Technol., 1: 165-9(Apr. 1968).

Tritium as a whole-body irradiator presents some problems to its users. Detection and measurement of titium, liquid scintillation counting, bioassay of tritium, and control of its hazard are discussed. (auth)

9858 USE OF THE RADIOIMMUNOLOGIC METHOD FOR DETERMINING THE PLASMA DOSE OF THE HUMAN LUTEINIZING HORMONE. IMPROVEMENT OF THE DOSAGE TECHNIQUE. Dolais, Jacqueline; Freychet, Pierre; Rosselin, Gabriel (NSERM, Paris). Compt. Rend., Ser. D, 267: 1105-8(Sept. 23, 1968). (In French).

A method was perfected for the determination of plasma luteinizing hormone (L.H.) by using a highly purified human luteinizing hormone (H.L.H.) both for iodation and for the establishment of the standard curve and human chorionic hormone for immunizations. The plasma L.H. was determined by the Berson–Yalow radioimmunologic method. The method is extremely sensitive and highly specific, differentiating the L.H. from the follicle-stimulating hormone and the thyroid-stimulating hormone. (J.S.R.)

9859 X-RADIATION EFFECTS ON MICE THYMUSES. II. LOCALIZATION OF ACID PHOSPHATASE ACTIVITY NEAR THE CORTICAL AND MEDULLAR REGIONS. Gibertini, Giancarlo. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 44: 477-81(Mar. 1968). (In Italian).

The effect of x rays on the activity of acid phosphatase, lysosomial enzyme, was studied in thymuses of young mice. One day after irradiation the cortex displayed a highly acid phosphatase activity, while the values of the medullar enzymatic activity remained much lower. This enzyme is localized in all the Hassal bodies of the irradiated thymuses; the hypothesis that the latter may take part in processes of phagocytosis is discussed. (auth)

9860 PROTEIN–PROTEIN ASSOCIATIONS AND THE EFFECTS OF GAMMA RADIATION ON SOLID STATE ASPARTATE TRANSCARBAMYLASE FROM ESCHERICHIA COLI. Bigler, William Norman. Boulder, Colo., Univ. of Colorado, 1968. 138p. Thesis.

Aspartate transcarbamylase (ATCase) from Escherichia coli was purified and studied as a heterogeneous protein preparation and as a homogeneous enzyme. Polyacrylamide gel electrophoresis of the heterogeneous preparation separated four (and sometimes five) ATCase active protein bands. These bands were partially characterized by their allosteric and catalytic properties. The principal ATCase active species in the heterogeneous preparation was identical to the homogeneous preparation. Evidence was presented that established the slowly migrating ATCase active proteins in the heterogeneous mixtures as aggregates of ATCase molecules. Conditions for the lyophilization of ATCase with complete retention of allosteric and catalytic properties are described. Aspartate transcarbamylase was lyophilized, irradiated in vacuo with γ radiation from ^{137}Cs (0.388 Mrads per hr), redissolved in buffer under a nitrogen atmosphere, and assayed for enzyme activity. The average D_{37} observed with saturating substrate, 25 mM aspartate, was 4.1 Mrads. With less than saturating substrate, 5 mM aspartate, the activity increased from zero to 1.6 Mrads and then decreased with a D_{37} of 7.2 Mrads. Inclusion of 1 mM CTP in the latter assay mixtures resulted in a more pronounced maximum in the activity curve occurring at slightly higher dose, 2.2 Mrads. Inhibitability by CTP had a D_{37} of 2.3 Mrads with doses below the activity maximum. Enzyme lyophilized in the presence of 1 mM CTP had a D_{37} of 2.8 Mrads. Hydrodynamic properties of the molecule suggest that in the presence of CTP the D_{37} should be slightly larger than 4.1 Mrads rather than smaller. Irradiated labeled enzyme was fractionated by sucrose density gradient centrifugation. Doses of up to 8.5 Mrads did not grossly alter the sedimentation properties of over 80% of the enzyme. The effect of radiation on ATCase in lyophilized bacteria were qualitatively like that observed with homogeneous enzyme in vitro. Apparent radiation sensitivities of ATCase in lyophilized bacteria were observed to vary with the technique used to disrupt the resuspended bacteria. A tentative scheme involving transfer of absorbed radiation energy between subunits is suggested as an explanation of the observed results. (Disser. Abstr.)

9861 EFFECTS OF HYDROCORTISONE, ACETYLSALICYLIC ACID, AND ULTRAVIOLET IRRADIATION UPON LYSOSOMAL MEMBRANES OF RAT LIVER CELLS IN VITRO. Kalczak, M.; Sieinski, W. (Second Central Hospital, Warsaw). Folia Histochem. Cytochem. (Krakow), 6: 107-11(1968).

The effects of hydrocortisone, acetylsalicylic acid, and uv irradiation on lysosomal membranes of rat liver cells were studied. It was shown that hydrocortisone and acetylsalicylic acid when applied in therapeutic concentrations produced a stabilizing effect on the membranes in vitro, whereas uv irradiation induced evident impairment. (F.M.M.)

9862 ACTIVATION OF A CYTOSTATIC (CYCLOPHOSPHAMIDENDOXAN) BY IONIZING RADIATION. PART II. THE POSSIBILITY OF USING IRRADIATED ENDOXAN FOR THERAPY OF MALIGNANT DISEASES. Tachiiri, Hiromu; Gamo, Tetsuo; Yoshimura, Shosuke; Shigematsu, Yasushi; Hara, Kazuo; Yoshii, Giichi; Iwo, Kazuhiro (University Hospital, Osaka. Osaka Univ.). Strahlentherapie, 136: 241-9(1968). (In German).

Endoxan (EX) irradiated with 10^9 R of ^{60}Co γ rays contained nor-nitrogen mustard (nor-HN_2) and substances that could be separated by paper chromatography at R values between 0 and 0.3. Irradiated EX showed an activated cytostatic effect on HeLa cells and was even more effective than nor-HN_2. At in vitro screening it had a carcinostatic activity. The effect on survival of irradiated EX was lower than that of non-irradiated EX. Irradiated EX was active at the infusion therapy on VX_2 carcinoma. The activity of irradiated EX was rapidly neutralized by the serum of cows. (auth)

9863 THE EFFECT IN HUMANS OF EXERCISE ON RELATIONSHIP BETWEEN SIMULTANEOUSLY MEASURED ^{133}Xe AND ^{24}Na CLEARANCES. Strandell, T.; Shepherd, J. T. (Mayo Graduate School of Medicine, Rochester, Minn.). Scand. J. Clin. Lab. Invest., 21: 99-107(Apr. 1968).

In four normal men the clearance rates of ^{133}Xe and ^{24}Na from a forearm muscle depot were followed at rest and during and after light to maximal forearm exercise. The analyzers were set to record the primary γ radiation from ^{133}Xe and ^{24}Na, respectively. The Na-detector recorded only γ radiation from ^{24}Na. The Xe detector recorded both the primary γ radiation from ^{133}Xe and ^{24}Na Compton scatter of energy similar to the ^{133}Xe primary radiation. The percentage of the activity in the Na detector that was recorded in the Xe detector was determined in all subjects by in-

jection of only ^{24}Na in the forearm flexor muscles. The mean value was 17.5%. This % of the ^{24}Na counts was subtracted from the total counts of the Xe detector. As the counting rate generally was about three times higher in the Xe detector, the initial correction for the ^{24}Na activity in the Xe detector corresponded to about six percent of the total activity. At rest the clearance rates were similar, but with maximal exercise the clearance of ^{24}Na increased only ten times compared to 30 times for the clearance of ^{133}Xe, indicating a diffusion limited clearance of ^{24}Na at high blood flows. The data were used to calculate a permeability-surface area product for the transport of Na from tissue to blood, a measure of the maximal diffusion capacity for Na. This value increased successively with rising work load and about sixfold from rest to maximal exercise. The increase with exercise was considered to reflect an increase in capillary surface area and probably also variations in a nonuniform capillary circulation. (BBB)

9864 DEOXYCYTIDINE AND RADIATION RESPONSE: EXCEEDINGLY HIGH DEOXYCYTIDINE AMINOHYDROLASE ACTIVITY IN HUMAN LIVER. Zicha, Blahoslav; Buric, Lubomir (Charles Univ., Prague). Science, 163: 191-2(Jan. 10, 1969).

The activity of deoxycytidine aminohydrolase in the liver of various species including man was investigated. An enormously high activity was found in human liver. This fact explains the extraordinarily low level of deoxycytidine in human urine in comparison with that of other tested species. The suitability of deoxycytidinura as a biochemical indicator of postirradiation damage in man remains, therefore, an open question. (auth)

9865 ON CERTAIN BIOCHEMICAL AND HISTOCHEMICAL CHANGES IN LIPID METABOLISM DUE TO PROLONGED ORAL ADMINISTRATION OF ^{144}Ce. Shagoyan, A. G.; Lavrent'ev, L. N. Vop. Radiobiol., Sb. Tr., 5: 265-71(1965). (In Russian).

Experiments on 200 white male rats given chronic oral administration of ^{144}Ce are described. The isotope was administered in the form of its chloride solution in the dose of 1.6 microcurie per rat daily, during 120 days. On various dates of the treatment the rats were sacrificed and the contents of general lipids, cholesterol and lipoid phosphorus were determined in their organs and tissues (blood, liver, brain tissue). Histochemical examination of the liver was simultaneously carried out. The results obtained were compared with those of the controls. The experimental data show that chronic oral administration of ^{144}Ce brings about an early increase in the contents of general lipids, cholesterol and lipoid phosphorus in the blood, liver, and brain tissue with their subsequent rapid normalization. This seems to characterize oral administration of the isotope. (auth)

9866 CHANGES IN CALCIUM CONTENT AND ACTIVITY OF BLOOD SERUM ALKALINE PHOSPHATASE DUE TO EFFECT OF ^{90}Sr AND ULTRAVIOLET RADIATION. Mirzoyan, A. A.; Shagoyan, M. G. Vop. Radiobiol., Sb. Tr., 5: 245-9(1965). (In Russian).

The study was carried out on male rats weighing 160–180 gr, to examine some changes in calcium content and in activity of blood serum alkaline phosphatase due to a chronic effect of radioactive ^{90}Sr and of uv radiation as well. The experimental results show that daily ultraviolet irradiation of white rats with a dose of 420 microcuries per min/cm^2 brings about a distinct and fairly steady increase of phosphatase activity. Due to the effect of ^{90}Sr, the alkaline phosphatase activity decreases. Ultraviolet irradiation, apparently intensifying mineral metabolism in the bone tissue, determines increased accumulation of ^{90}Sr. (auth)

9867 SOME CHANGES OF LIPID METABOLISM IN RATS AFTER SINGLE INTRAABDOMINAL INJECTION OF RADIOACTIVE CERIUM. Shagoyan, A. G. Vop. Radiobiol., Sb. Tr., 5: 229-35(1965). (In Russian).

The contents of general lipids, cholesterol, and lypoid phosphorus were determined in the blood serum, liver, and brain tissue by photocalorimetric methods 15, 30, and 60 days after injection of ^{144}Ce. The experimental results showed that the earliest changes occurred in the blood serum and in the liver. The content of general lipids and cholesterol was considerably decreased. The decrease of lipid fraction contents was observed in the brain tissue as well but only on the 60th day of injection. The early changes in the serum lipids (blood and liver serum) and the later response of the brain tissue are due to the fact that ^{144}Ce, injected intraabdominally, is rapidly removed from the liver and is concentrated in the skeleton and in the skull bones as well. (auth)

9868 EFFECT OF IONIZING RADIATION UPON ELECTROPHORETIC PROTEIN CONTENT OF BLOOD SERUM IN RABBITS. Pogosyan, M. O. Vop. Radiobiol., Sb. Tr., 5: 205-14(1965). (In Russian).

Single total x irradiation of rabbits with a dose of 800 R decreased the level of albumin and increased that of globulin in the blood serum. The rise of the globulin level occurred at the expense of increase of α and β-globulins. The method of paper electrophoresis permitted a tentative conclusion that changes took place in fractional protein composition of the blood serum because of ionizing radiation. (auth)

9869 CHANGES OF PREVENTIVE PROPERTIES OF BLOOD SERUM IN RABBITS DUE TO SINGLE X IRRADIATION AND TYPHIZATION. Pogosyan, M. O. Vop. Radiobiol., Sb. Tr., 5: 191-6(1965). (In Russian).

Single irradiation of rabbits with a dose of 500 R results in decreasing the level of preventive properties of their blood serum which is not completely normalized until the 40th day after irradiation. If 24 hours after irradiation a thrice-repeated typhization is carried out, then a depressing radiation effect upon the serum preventive properties is mitigated and the restoration of serum activity becomes more evident. (auth)

9870 ANTIBODY FORMATION IN IRRADIATED RABBITS SUBJECTED TO SINGLE AND THRICE-REPEATED MONOTYPHIZATION. Pogosyan, M. O. Vop. Radiobiol., Sb. Tr., 5: 183-90(1965). (In Russian).

Repeated typhization of rabbits in conditions of their preliminary x irradiation (500 R) is reported to secure satisfactory production of antibodies (agglutinins). In various periods after irradiation the results of thrice-reported and single typhization, followed by retyphization, are equalized. No strict parallelism between the antibody titre and the leukocyte count is observed. The optimal time of the immunization outset is the second day after irradiation. (auth)

9871 EFFECT OF ADRENALIN ON CERTAIN ASPECTS OF CARBOHYDRATE METABOLISM IN IRRADIATED BODY. Kheifets, Yu. B.; Vlasenko, S. P. Vop. Radiobiol., Sb. Tr., 5: 161-8 (1965). (In Russian).

A single injection of adrenaline brings about the development of severe glycogenolysis in leukocytes of the peripheral blood, mostly pronounced 1 to 3 hours after injection. Similar phenomena are observed in irradiated animals. Preliminary adrenalectomy reduces response of the peripheral blood leukocytes to radiation effect. (auth)

9872 INFLUENCE OF X IRRADIATION UPON ABSORPTION PROCESS OF MAIZE OIL, DEPENDING ON DEGREE OF FAT DISPERSION. Shagoyan, A. G. Vop. Radiobiol., Sb. Tr., 5: 169-76(1965). (In Russian).

Influence of external x irradiation (300 R) upon the process of absorption of maize oil and its emulsion in dogs is discussed. The experimental results show that under normal conditions maize oil and its emulsion are absorbed almost equally 3 to 4 hours after the fat is given. The process of fat absorption is severely depressed one day after irradiation while on the fourth day this process is normalized. Further, on the 7 and 19th day the process remains depressed. In the above periods of time the maize oil in an emulsion form is absorbed fairly well. The data obtained justify the expedience of introducing finely dispersed fats into the diet of irradiated individuals. (auth)

9873 ABSORPTION FROM THE SYNOVIAL CAVITY IN RABBITS AND CATS. THE INFLUENCE OF DIFFERENT ENVIRONMENTS AND DRUGS. Sallis, J. G. (Oasim Medical Center, Port Elizabeth, South Africa); Perry, B. John. S. Afr. J. Med. Sci., 32: 83-95(Oct. 1967).

Absorption of intraarticularly injected ^{131}I, ^{131}I-serum albumin (RISA), ^{22}Na, and ^{32}P was studied. A method was described for estimating the rate of absorption of radioactive substances injected into the synovial cavity of a rabbit's knee joint by external counting. The shape of the clearance curve was discussed. The initial slope of the clearance curve was used as a measure of rate of absorption and the effect of temperature, passive work, transection of the cord, and concurrent intra-articular injection of a range of drugs on the absorption was shown for radioiodide. RISA was used to show the pattern of absorption for a large molecule. Radiosodium, ^{22}Na as the chloride, when injected, gave absorption curves with first half-clearance of 12.4 to 18.7 min. In a rabbit injected with ^{22}Na and also given 0.5 mg of hydrocortisone, the half-clearance was 5.8 min. These figures compared well with those using ^{131}I. When a rabbit was given intravenously a saturating volume of normal saline prior to the injection of ^{22}Na into the synovial cavity of the knee, the clearance curve had a first slope of 25 min, an early elbow, and a long second half-clearance. Three experiments with cats instead of rabbits enabled the absorption path of RISA into the lymphatic system to be clearly demonstrated. Histological examination of sections made from each injected knee were discussed. (BBB)

9874 BONE MARROW AS THE SOURCE OF CELLS IN SKIN REACTIONS OF DELAYED HYPERSENSITIVITY. Lubaroff, David Martin. New Haven, Yale Univ., 1968. 105p.

Thesis.

Splenectomy or thymectomy of adult Lewis rat 10 days after sensitization with tubercle bacilli did not affect the development of delayed skin lesions upon skin testing with PPD. The presence of the thymus also had no significant effect on results in subsequent passive transfer experiments. The passive transfer of delayed hypersensitivity and the elicitation of intense reactions in thymectomized, x-irradiated rats depended on the prior injection of normal bone marrow cells. When the transfer was performed shortly after irradiation, high doses of marrow cells were required to obtain reactions of reasonable intensity. If, however, periods of 7 to 10 days were allowed to elapse between the injection of the bone marrow and lymph node cells, lower doses of marrow were sufficient to produce comparable reactions. Normal thymus, spleen lymph node or peritoneal exudate cells were inefficient, even at high doses, in producing good tuberculin reactions when used in lieu of the bone marrow. With the technique of immunofluorescence, the precise origin of the cells infiltrating the delayed skin reaction was studied. Thymectomized, irradiated Lewis rats were restored with bone marrow from allogeneic or F_1 donors. They were passively sensitized to tuberculin by a subsequent transfer of Lewis lymph node cells and were given intradermal skin tests with tuberculoprotein. In 24-hour skin reactions the majority of cells were shown to be derived from the infused bone marrow. These results were the same regardless of whether the lymphocyte transfer was performed on the day of irradiation and marrow injection or seven days later. The cells in the tuberculin reactions, marrow, spleen and lymph nodes not derived from the bone marrow were found to originate in the transferred lymph node cells. (auth) (Diss. Abstr.)

9875 CHEMICAL EVOLUTION AND THE ORIGINS OF PREBIOLOGICAL SYSTEMS. Dose, Klaus (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Umsch. Wiss. Tech., No. 21, 683-8(1967). (In German).

The conditions on the earth before life evolved—especially the absence of atmospheric oxygen—were investigated, and the connection between chemical and biological evolution was shown. The energy sources for both types of evolution were evaluated. Experiments are described where—under conditions simulating a primitive planet without life—biologically important components were synthesized from simple molecules. The experimental features involved exposure of the basic material to irradiation, studies of the effect of temperature, the trigger function of electric discharges, and polymerization processes that lead to the formation of prebiological systems such as microspheres and coacervate systems. (IAA)

9876 CONVERSION OF CYTIDINE TO DEOXYCYTIDINE IN REGENERATING RAT LIVER. King, Conrad David. Madison, Wis., Univ. of Wisconsin, 1968. 85p.

Thesis.

The biosynthesis of deoxyctidylates in regenerating rat liver was studied in both in vivo and in vitro systems. Tritium-labeled cytidine was incorporated in vivo into DNA. The uptake increased from 0.5 to four hrs after administration and lagged behind the incorporation of both ^{3}H-TR and ^{3}H-dCR. Direct reduction of ^{3}H-CDP to ^{3}H-dCDP was performed in vitro with a high speed supernatant obtained from regenerating rat livers. Characterization of the CDP reductase indicated that it was activated by ATP up to a specific concentration, but was inhibited by higher or lower levels of ATP. In this system, the reductase had no absolute requirements for a sulfhydryl protecting agent and it functioned best at pH 8 in phosphate buffer. CDP reductase activity was blocked by hydroxyurea (but not urea) in vitro, and was sensitive to both whole-body irradiation and the administration of actinomycin D. Hydroxyurea completely blocked ^{3}H-CR uptake and partially inhibited the in vivo incorporation of TR, dCR, and dUR into DNA, but did not inhibit the in vitro polymerization of newly formed DNA. Reductive enzyme activity first appeared in 18 hrs after hepatectomy and increased through 33 hours. Normal and sham-operated controls did not show any activity; hence, from the experiments with x irradiation and actinomycin D, it appeared that the enzyme was formed de novo starting at about the same time as DNA synthesis. (auth) (Diss. Abstr.)

9877 EFFECT OF DIRECT CURRENT AND X IRRADIATION ON ACTIVITY OF BLOOD CATALASE IN NARCOTIZED RATS. Gabrielyan, R. A.; Arutyunyan, R. K. Vop. Radiobiol., Sb. Tr., 5: 137-40(1965). (In Russian).

Blood catalase in irradiated rats (800 R) under the effect of galvanic irritation in conditions of nembutal narcosis has been examined. The experimental data show that the central nervous system (CNS) switching off by means of narcosis somewhat decreases the irradiation depressing effect upon the activity of the blood catalase. The CNS switching off also decreases the degree of radioprotective effect of anodic current. (auth)

9878 EFFECT OF DIRECT CURRENT ON THE LEVEL OF NUCLEOPROTEIDS, GLYCOGENS, AND FAT IN SURVIVED IRRADIATED RATS. Arutyunyan, R. K.; Ezdanyan, B. A.; Manvelyan, K. R.; Manukyan, L. A. Vop. Radiobiol., Sb. Tr., 5: 85-93 (1965). (In Russian).

Histochemical studies of the level of nucleic acids and glycogen in the liver as well as that of fat in the adrenal cortex were carried out on 50 rats survived during 30 days after irradiation. The results obtained show that the most pronounced decrease of the level of the components under investigation is noted in the series of the animals x irradiated with a dose of 800 R. The content of the above components was also below the normal in the irradiation series with cathodization of the brain, and in the series with extracerebral irritation and irradiation of the rats. The histochemical components were changed last of all in the rats which were irradiated simultaneously with anodization of the brain. (auth)

9879 EFFECT OF IONIZING RADIATION ON FERMENT-MUCOPOLYSACCHARIDE SUBSTANCES. Papoyan, S. A.; Alaverdyan, M. I.; Airapetyan, F. O. Vop. Radiobiol., Sb. Tr., 5: 5-11(1965). (In Russian).

X rays were shown both in vitro and in vivo (in samples with mixer for leucocytes, in viscosimetric test and in the reaction of McClean-Smirnov) as in observations on animals (white mice and rats) to destroy hyaluronic acid. Irradiation of the animals, followed by destruction of the organ tissue, brings about release of tissue hyaluronidases which ferment hyaluronic acid in the organs. As a result the tissue permeability increases. The foregoing shows that the ferment-tissue system, i.e. hyaluronidase-hyaluronic acid, plays an important role in the genesis of radiation syndrome, in the development of radiation sepsis and hemorrhages in particular. (auth)

9880 APPLICATIONS OF GAMMA-RAY ANGULAR CORRELATIONS TO THE STUDY OF BIOLOGICAL MACROMOLECULES IN SOLUTION. Leipert, T. K. (Stanford Univ., Calif.); Baldeschwieler, J. D.; Shirley, D. A. Nature (London), 220: 907-9 (Nov. 30, 1968).

It is stated that although angular correlations are used to study nuclear properties, and have been applied to studies of the properties of solids, the technique has not previously been applied to the study of macromolecules in solution. Studies are reported on the effects of molecular conformation on the angular correlation pattern of gamma rays following the decay of ^{111}In interacting with binding sites of some biological molecules in solution. The use of a radioactive nucleus as a "rotational" tracer offers sensitivity, instrumental simplicity, and in vivo applicability. The biological molecules studied were bovine serum albumin (BSA) and polyglutamic acid, and the angular correlation measurements were made with a 4-detector delayed coincidence spectrometer. BSA undergoes a conformational transition between pH 5.7 and 2.8, and changes in the angular correlation may reflect changes in the effective rotational correlation time at the binding sites of ^{111}In, or they may simply reflect a change in the effective binding constant. At pH 5.7 the protein may be more rigid, giving a larger perturbation in the angular correlation. The effect of adding urea solution was also investigated; the effect was large and in the direction expected for denaturation of the molecule, leading to smaller perturbations of angular correlation times. It is concluded that the angular correlation method should find considerable further application to studies of biological macromolecules. (UK)

9881 THE STANDARDIZATION OF A REPRODUCIBLE IN VITRO TECHNIQUE FOR THE MEASUREMENT OF ^{86}Rb UPTAKE IN THE HUMAN ERYTHROCYTE. Castronovo, Frank P.; McIntyre, Patricia A.; Stern, Howard S. (Johns Hopkins Medical Institutions, Baltimore). Int. J. Appl. Radiat. Isotop., 19: 781-8 (Nov. 1968).

Using the described technique, duplicate samples from 11 normal subjects were evaluated over a 24 hr period at the following time intervals: 0, 5, 15, 30, 45, 60, and 75 min and 6, 12, and 24 hr. The percent uptake per ml of packed RBC versus time (0 to 5 min) was plotted on linear graph paper for each subject and the slope of the resulting curves was calculated. The remaining time observations, 6, 12, and 24 hr, were utilized for calculation of the equilibrium time of rubidium in the erythrocyte. The mean ±S.D. for the 20 individual slopes was 0.237 ± 0.016 and the slope of the combined curve 0.222 percent ^{86}Rb uptake/minute. The percent ^{86}Rb uptake at 6 hr was 52 ± 3 percent, at 12 hr it rose to 75 ± 4 percent, and at 24 hr the value was 78 ± 2 percent. The error in measurement of ^{86}Rb uptake between individuals, and in repeated measurements with the same individual, was statistically similar at the ninety-five per cent level of confidence. (auth)

9882 HISTOCHEMICAL AND SUBMICROSCOPIC STUDIES OF THE CHROMOLIPOID PIGMENT IN THE THYMUS OF NORMAL AND IRRADIATED RATS. Nicolato, A.; Garbagna, P.

(Univ., Pavia, Italy). Radiobiol. Radioter. Fis. Med., 23: 75-106(Mar.-Apr. 1968). (In Italian).

Macrophages of the thymus of rats are rich in chromolipoid pigment. Problems of the genesis and nature of such pigments and of the relation between them and lysosomes were investigated in the thymus of normal rats and of rats irradiated with x rays. From the results obtained mainly in the irradiated thymus it was concluded that chromolipoids are identifiable with lysosomes. (C.H.)

9883 REACTION OF DIPHENYLPICRYLHYDRAZYL WITH SYNTHETIC AND NATURAL MELANIN. Slonicki, Alex. Washington, D. C., Georgetown Univ., 1968. 164p.

Thesis.

The reaction between diphenylpicrylhydrazyl, a stable free radical, and melanin, natural and synthetic, was studied in order to establish some of the properties of melanin. The reaction between melanin, synthetic or natural, and diphenylpicrylhydrazyl was followed with time by the decrease in the absorbance of diphenylpicrylhydrazyl at 517 mμ. The reactivity of both types of melanin with diphenylpicrylhydrazyl was identical, the initial fast reaction rate was followed by a slower rate. However, a difference in the reactivity between synthetic and natural melanins with diphenylpicrylhydrazyl was observed after the two types of melanin were pre-incubated with chloroquine or cupric ions. In case of natural melanin, the reactivity with diphenylpicrylhydrazyl was unchanged when compared to a control, while the reactivity of the synthetic melanin was markedly decreased after the incubation with an identical agent. This dichotomy in reactivity shows the ability of an agent, such as chloroquine, to decrease the efficiency of the polymer to react with the free radical, diphenylpicrylhydrazyl. In addition, the absence of a protein-like material surrounding the melanin polymer was reflected in the greater binding of chloroquine to the synthetic melanin (186 μg of chloroquine base per mg of melanin) as compared to its binding to natural melanin granules (40 μg of chloroquine base per mg of melanin granules). The reactivity between melanin and diphenylpicrylhydrazyl could not be enhanced by continuous uv irradiation of the melanin at room temperature. This was in keeping with the result obtained by using electron spin resonance spectroscopy which established that the reaction proceeded by a hydrogen abstraction by diphenylpicrylhydrazyl from melanin rather than being a radical-radical interaction. On the basis of these observations and the reported effects of chloroquine on patients who were on long term, high dosage therapy, a possible explanation for chloroquine toxicity could be presented. (Diss. Abstr.)

9884 THYMUS DEPENDENCE OF ANTIBODY RESPONSE: VARIATION WITH DOSE OF ANTIGEN AND CLASS OF ANTIBODY. Taylor, R. B.; Wortis, H. H. (National Inst. for Medical Research, London). Nature (London), 220: 927-8(Nov. 30, 1968).

Cells which produce γG antibody are more dependent on the presence of a thymus than those which produce γM antibody; this conclusion was based on studies carried out with lethally irradiated mice repopulated with fetal liver cells and grafted with a syngenic thymus. It has been suggested that the suppressive effect of thymectomy can be to some extent over-ridden by large doses of antigen. In the studies described thymectomized and non-thymectomized mice were immunized with different doses of sheep red blood cells (RBC) and the response measured in terms of cells producing four different classes of immunoglobulin. The mice were sub-lethally irradiated (600 R). It was found that it took at least a 1,000-fold greater amount of antigen in thymectomized irradiated mice to reach a level of response equivalent to that of non-irradiated non-thymectomized mice. It was shown that the efficency of sheep RBC as antigen was increased up to 100-fold by the presence of a thymus, and strong support was afforded to the idea that the thymus is necessary for the normal function of an antigen handling step. (UK)

9885 IMMUNE PARALYSIS OF THYMUS CELLS BY BOVINE SERUM ALBUMIN. Taylor, R. B. (National Inst. for Medical Research, London). Nature (London), 220: 611 (Nov. 9, 1968).

It was observed that the immune response to various antigens, including BSA, of mice thymectomized in adult life, heavily irradiated, and injected with bone marrow could be restored by injection of dissociated thymus cells. It was also shown that the transfer of thymus cells alone to irradiated mice did not restore their antibody response to sheep erythrocyte antigens, but that these cells would act in this capacity in cooperation with bone marrow cells. Experiments are described with a view to demonstrating thymus-marrow cooperation when BSA was used as antigen, and an investigation was made to determine which of these two cell types carried the specific alteration involved in immune paralysis. The mice were irradiated with 900 R. It was found that for a constant dose of thymus cells the response declined with declining doses of marrow cells, and with a constant dose of marrow cells the response declined with declining doses of thymus cells. In further experiments it was found that pretreatment of donors of thymus and marrow cells with BSA one day before cell transfer made the thymus cells but not the marrow cells unresponsive to BSA. ^{131}I-BSA was employed in measurement of the quantity of BSA which penetrated to the donor cells and was transferred to the recipients. (UK)

9886 MEMBRANE ENZYME SYSTEMS: MOLECULAR SIZES FROM TARGET THEORY ANALYSIS OF RADIATION INACTIVATION DATA. Kepner, Gordon Rolfe. Berkeley, Calif., Univ. of California, 1968. 104p.

Thesis.

Classical radiation target theory is exploited to obtain values for the molecular weights of various membrane-bound enzyme systems. From data in the literature a calibration curve was obtained relating enzymes of known molecular weight to that radiation dose at which 37% of the initial activity remained (D_{37}). The D_{37} value for the membrane enzymes was obtained from a plot of enzyme activity against radiation dose for freeze-dried membranes irradiated in vacuo by 7.5 MeV electrons. Enzymes of especial interest include the Na-K stimulated ATPase of cell membranes, thought to be associated with active transport processes. A mol wt of ~250,000 was obtained for the Na-K ATPase in red cell ghosts, kidney cortex microsomes or plasma membranes, and crayfish nerve cord. This number in addition to a value for the number of enzyme sites in the red cell enabled an estimate to be made for the volume fraction of the membrane devoted to active cation transport (6%). It was also calculated that the specific activity of pure red cell membrane Na-K ATPase would be about 40 μmoles Pi/mg-hr. Other results suggested that the Mg-ATPase and the Na-K ATPase had the same mol wt. This is consistent with the concept of one enzyme system capable of different expressions. Studies with alkaline phosphatase in microsomes revealed a mol wt estimated at 140,000. Thus the possibility is raised that the Mg and Na-K ATPase system consists of two sub-enzymes, a phosphorylase and a phosphatase, that are different in size, each being essential for function of the whole. Mitochondrial ATPases, stimulated by the divalent cations Mg and Ca, had a mol wt of about 400,000. Investigations of electric eel acetylcholinesterase (AChase) and red cell ghost AChase suggested mol wt values of 190,000 and 70,000 respectively. The former estimate is in agreement with a value of about 240,000 for crystalline eel AChase. Experimental and theoretical analyses were also undertaken to establish the validity of the technique and the limitations on its application. In general, irradiations of dry samples must be carried out in vacuo. High dose-rates (about mrad/min) and the absence of salts or buffering compounds in the preparation are desirable. Room temperature is adequate and the D_{37} is not sensitive to fluctuations in this parameter. Some studies on ATPase and AChase using intact red cells and ghosts irradiated in the frozen state suggested that it might be possible to estimate mol wt from such data. The advantages in terms of sample preparation and variety of cell membrane functions one can measure are considerable. Finally, characterization of the Na-K ATPase in preparations of microsomes and plasma membrane from the same cell type (kidney cortex) was attempted. Microsomal and plasma membrane fractions apparently contain the same Na-K ATPase judged by similar responses to varying cation levels and/or ouabain concentration in the incubation medium. (Disser. Abstr.)

9887 DYNAMICS OF THE INTERACTIONS OF BASIC PROTEINS WITH POLYRIBONUCLEOTIDES. Preiss, John W. (Univ. of Delaware, Newark). Biophys. J., 8: 199-209(Feb. 1968).

Pancreatic ribonuclease was irradiated in the dried state with 7-KeV electrons to doses of 1.8×10^{14} electrons/cm^2 and then added to acetate buffer solutions that contained different concentrations of polyribonucleotides. Qualitatively similar results were obtained by adding a combination of unirradiated ribonuclease and lysozyme to such solutions. Such solutions scattered light strongly, and the intensity of the scattered light changed with time after mixing. The angular distribution of the scattered light was obtained as a function of time and compared with the rates at which hydrolysis products were formed. The turbidity of the solutions increased rapidly with time at the lower polyribonucleotide concentrations, and seemed to result from a complex between radioinactivated ribonuclease, or lysozyme, and oligonucleotides that appeared during enzymic hydrolysis of the polynucleotides. The dissymmetry of the scattered light was 5, indicating that the scattering centers are, if spherical, about 1500 Å in dia. The turbidities were remarkably high considering the low concentrations of protein and nucleic acid materials used. (BBB)

9888 EFFECT OF IONIZING RADIATION ON THE MOLECULAR WEIGHT DISTRIBUTION OF DOUBLE STRANDED DNA OF MAMMALIAN METAPHASE CHROMOSOMES. Corry, Peter Matthew. Houston, Tex., Univ. of Texas Graduate School of Biomedical Sciences, 1968. 116p.

Thesis.

The effect of ionizing radiation on the molecular weight distribution of double stranded DNA in mammalian cells was determined by placing isolated metaphase chromosomes directly onto sucrose gradients that contained sufficiently high salt concentrations to remove greater than 95% of the protein from DNA. Chinese hamster cells (Don-C strain) were arrested in metaphase with colcemid and harvested by mechanical shaking. The chromosomes were then obtained using a single step lysis and purification procedure and a buffer system that was designed to inhibit DNAase activity. The DNA in the chromosomes was labeled by incubation of the cells for 1.5 generation times in the presence of tritium-labeled thymidine. The sedimentation characteristics of the DNA were determined by layering preparations of the isolated chromosomes onto preformed sucrose density gradients. The sucrose gradients were of the constant velocity type that contained either 5 M sodium chloride or 5 M sodium perchlorate. The mol wt of the DNA was calculated from the sedimentation coefficient, $S_{20,w}$. In untreated controls the peak molecular weight of the DNA was approximately 225×10^6 daltons. Inclusion of mercaptoethanol and hydroxylamine into the gradients did not affect sedimentation patterns. The extent of double strand scission of the DNA, following irradiation of the chromosomes with ^{137}Cs γ rays was 1.05×10^{11} breaks per gram-rad (approximately 600 eV of deposited energy per break). Within experimental error no difference could be detected between intracellular irradiation of chromosomes or irradiation of chromosomes after isolation from the cells. Irradiation of isolated chromosomes in the presence of cystamine resulted in at least a seven fold reduction in the apparent double strand scission. Theoretical simulation of radiation induced double strand scission for experiments involving more than one dose point was carried out using an IBM-7094 computer and a program that assumed random selection and scission of molecules. The results of these theoretical simulations, coupled with observations in control studies, suggested that the mol wt of at least 80 to 90% of the intact DNA molecules in the chromosomes were distributed normally with a mean of approximately 200×10^6 daltons and a standard deviation of approximately 50 to 10^6 daltons. Only this model for the mol wt of the DNA in the chromosomes was consistent with the experimentally observed data. (Disser. Abstr.)

9889 IONIZING RADIATION. Cronkite, Eugene P.; Chanana, Arjun D. pp 423-39 of Human Transplantation. New York, Grune and Stratton, Inc., 1968.

A review of the literature on the effects of radiation on the immune reactions of transplantations is presented. The radiosensitivity of the lymphocytes is emphasized because of their role in the process that results in rejection of allotransplanted tissues. The use of whole-body irradiation as an adjunct to renal transplantation in humans is discussed. Other types of irradiation used are extracorporeal irradiation of blood and lymph, reduction of the number of lymphocytes by the use of radioisotopes, and irradiation of the transplanted organ. The following methods for parenteral administration of radioisotopes are described: subcutaneous injection of ^{111}Ag and ^{206}Bi; intralymphatic injection of ^{131}I and ^{32}P; intravenous injection of ^{90}Y-DTPA, ^{203}Hg-chlormerodrin, and ^{198}Au; and implantation of ^{90}Sr-^{90}Y. Irradiation of the spleen and thymus in order to suppress the lymphoid cells is discussed. Clinical and experimental local irradiation of renal transplants is described. Graphs are presented to show the influence of extracorporeal irradiation of blood on the number of lymphocytes in the peripheral blood. The use of imuran and thymectomy as adjuncts to extracorporeal irradiation of blood is discussed. The influence of extracorporeal irradiation of thoracic duct lymph on skin allograft rejection in calves was studied. Extracorporeal irradiation of blood and lymph are being used clinically to deplete the body of lymphocytes prior to allografting, to maintain depletion after allografting, and to aid in the treatment of rejection crises. (H.L.W.)

9890 STUDIES ON MUTAGENESIS INDUCED IN VITRO. Grossman, Lawrence (Brandeis Univ., Waltham, Mass.). Contract AT(30-1)-3449. Photochem. Photobiol., 7: 727-35 (June 1968).

The effective reduction of cytosine, whether in polymer form as a template or in monomer form as a substrate, is recognized in the RNA polymerase system as uracil or thymine. Reduction can be brought about by photohydration to form cytosine hydrate, reaction with hydroxylamine to form a 5,6-reduced monoadduct, or by direct chemical reduction. A novel tautomeric intermediate is postulated that has permitted the assay of cytosine hydrates in native and denatured DNA. It is suggested that the most probable uv photoproduct responsible for the mutagenesis of DNA is the cytosine hydrate. Similar modification of uracil or thymine resulted in loss of recognition at both polymer and monomer levels. Reiteration was observed when polyuridylic acid was either chemically reduced or irradiated with uv. The majority of the conclusions were based on experiments with the RNA polymerase from Micrococcus lysodeikticus and a DNA polymerase of Escherichia coli. Examination of the enzymatic sites at which uv photoproducts are introduced into the appropriate templates provided data bearing directly on the nature and scope of recognition in vitro. (auth) (TSS)

9891 BIOLOGICAL ACTION OF LASER IRRADIATION. Gorodetskii, A. A.; Kirichinskii, B. R.; Evdokimov, I. R. pp 222-9 of Voprosy Biofiziki, Biokhimii i Patologii Eritrotsitov. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The general characteristics of ruby lasers used in medicine are briefly reviewed. The development of relatively simple dosimetric methods for ruby lasers and their biological action on blood and tissues are discussed. A photographic photometry method is described that is considered simple and convenient for measuring absorbed irradiation doses. Using this method, the following were studied: stability of laser irradiation, absorption of laser irradiation, and effect of laser irradiation on staining of tissues. The biological action of laser irradiation was investigated in human blood preparations. In all experiments, an SU-1 type ruby laser (diameter of ruby rod—6.5 mm, length of ruby rod—80 mm, impulse—1 joule, impulse duration—5 msec, supply voltage—1 kV) for electrowelding of microscopic parts was used. Following focused irradiation of the laser (1, 2, 3, and 4 impulses), the blood preparations were stained according to Gimz. Basically, the effect of laser irradiation on blood elements is coagulation, enhanced by the presence of natural or artificial stains. Hemoglobin of erythrocytes is particularly sensitive to laser irradiation. The scattering of coagulated mass substance along the periphery is probably the result of a shock wave that accompanies coherent irradiation of a laser and is more sharply expressed with narrowing of the field diameter to 2.5 μ. EPR investigations of laser-irradiated white and colored guinea pigs and rabbits in vivo and in vitro showed that laser action on skin tissues leading to the appearance of free radicals was apparently related to the nature of the pigment bonds. (ATD)

9892 EFFECT OF IONIZING IRRADIATION ON GLYCOLYTIC ENZYME ACTIVITY AND ON ERYTHROCYTE RESISTANCE TO ACID HEMOLYSIS. Fedorova, A. L. (Medical Inst., Irkutsk, USSR). pp 233-9 of Voprosy Biofiziki, Biokhimii i Patologii Eritrotsitov. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

Erythrocytes of white male rats weighing 250 to 280 gm were investigated following exposure to several types of irradiation to determine the following: hexokinase activity, phosphohexose isomerase activity, and erythrocyte resistance measured by acid erythrograms and by ^{32}P uptake changes. Groups of white rats were exposed to γ irradiation (^{60}Co—unit, 35 cm focal length, 21.6 R/min dose rate, 600 R dose); γ irradiation combined with ^{32}P β irradiation (administered intraperitoneally 100 μc/300 g); and α irradiation (intraperitoneal administration of uranyl acetate). Animals were decapitated and blood was collected from the sectioned vessels. Erythrocytes were washed and hemolysates were prepared. Hexokinase activity was determined by the rate of glucose loss per/mg of hemolysate protein. Phosphohexose isomerase activity was determined with glucose-6-phosphate acting as a substrate. Findings showed that with γ irradiation of animals, a certain correlation was observed between erythrocyte resistance to acid hemolysis, erythrocyte uptake of ^{32}P and glycolytic activity of enzymes (hexokinase and phosphohexose isomerase). Gamma irradiation did not affect the glycolytic enzymes directly, but was related to disturbance of the hemopoietic system. The physicochemical property changes of the erythrocytes were probably a secondary process, but the direct effect of γ irradiation on the erythrocyte membrane in the early stages could not be excluded. The direct effect of γ irradiation on the erythrocyte was related to the action of short-lived free radicals appearing during radiolysis of water. The action of uranyl acetate ions, that induced the most marked changes in erythrocytes and hexokinase activity, was attributed to the blocking of the sulfhydryl groups in the thiol groups in hexokinase and possibly of other erythrocyte membrane components; and, this leads to reduced erythrocyte resistance. (ATD)

9893 ON THE COMPARATIVE EFFICACY OF DESFERRIOXAMINE AND DTPA AS AGENTS FOR THE ELIMINATION OF PLUTONIUM IN POISONED RATS. Truhaut, R.; Boudene, C.;

Lutz, M.; Metivier, H. (Univ., Paris). Arch. Mal. Prof. Med. Trav. Secur. Sociale, 27: 669-76(Sept. 1966). (In French).

Experiments were performed to determine the relative effectiveness of two chelating agents in eliminating Pu poisoning in rats. All 52 rats received a single intravenous injection of 10 μCi/Kg of Pu citrate. They were then divided into three groups, one of which received no further treatment. Another group received DTPA (diethylenetriaminopentacetic acid) treatment and the third group was treated with DFO (desferrioxamine B). Each treated group was further subdivided into two groups for differing times of treatment. One subgroup of six animals received three injections at six hr, three days, and five days after Pu administration. The other subgroup received injections at only three and five days after Pu. The amount of each injection was 0.15 mmole/Kg, i.e., 75 mg/Kg of DTPA and 100 mg/Kg of DFO. From the time of Pu contamination, assays were made of feces and urine. Elimination of Pu in the urine was about equally fast with DFO and DTPA. DFO increased Pu urinary excretion 20 fold and DTPA increased it 23 fold compared to control value when treatment began six hr after Pu poisoning. However, the elimination of Pu in the feces was definitely faster with DFO and of greater overall significance than that with DTPA. This was due to the fact that DFO is eliminated generally more quickly than DTPA. It was concluded that DFO should have a wider use as a chelating agent in radionuclide decontamination, because the risks of accumulation of the radiocontaminating material in the bones would be greatly lessened. (BBB)

9894 THE PITFALLS OF MEASURING DNA SYNTHESIS KINETICS AS EXEMPLIFIED IN ULTRAVIOLET RADIATION STUDIES. Smith, Kendric C.; O'Leary, Mary E. (Stanford Univ., Palo Alto, Calif.). Biochim. Biophys. Acta, 169: 430-8 (Dec. 17, 1968).

Previous reports on the effect of uv irradiation on the incorporation of radioactive precursors of DNA by bacteria have presented the data as linear plots of counts/min vs. time. Using this type of plot one only obtains the apparent rate of DNA synthesis in bacterial cultures because the slope of these curves depends in part upon trivial parameters such as the initial viable cell number and the specific activity of the radioactive precursor. The true rate of DNA synthesis only depends upon the DNA content per cell and their generation time. Examples are given to demonstrate that linear plots can lead to erroneous conclusions concerning DNA synthesis kinetics. A new protocol for studying the effect of radiation (and other agents) on macromolecular synthesis kinetics is presented that circumvents the pitfalls inherent in previous methods: use mutants requiring the labeled precursor (e.g., thymine), prelabel the cells and keep the radioactivity present after irradiation (equivalent to the direct chemical determination of DNA); plot the data as log counts/min vs. time (DNA synthesis is an exponential function in bacteria); and determine the kinetics of cell growth at the same time aliquots are taken for the determination of incorporated radioactivity (one may then hope to deduce the biological relevance of the observed synthesis). The advantages of this protocol over previous methods are documented and discussed with special emphasis on the measurement of the extent of delay in DNA synthesis in radiation-resistant bacteria as a function of dose of uv radiation. (auth)

9895 POLYRIBOSOME REDUCTION AND RECOVERY FOLLOWING NEUTRON EXPOSURE OF REGENERATING LIVER. Yatvin, Milton B.; Mitchen, Jacque L.; Wiley, Albert L. Jr.; Vogel, Howard H. Jr. (Univ. of Wisconsin, Madison. Argonne National Lab., Ill.). Biochim. Biophys. Acta, 169: 536-9(Dec. 17, 1968).

Exposure of rats to 300 rads of whole-body fast neutron radiation did not interfere with the regenerating liver polyribosome distribution pattern 24 hr after partial hepatectomy. The regenerating liver polyribosome distribution patterns from neutron-irradiated rats were similar to those from γ-irradiated animals 36 hr after partial hepatectomy. These patterns were characterized by a greater percentage of the ribosomes present in the large polyribosome region. This recovery was even more dramatically illustrated by a comparison between regenerating liver patterns of irradiated rats killed 24 or 36 hr after partial hepatectomy. In order to quantitate liver ribosome distribution, the absorbance curves were divided into light and heavy aggregate regions, and their respective areas determined by use of a planimeter. Possible mechanisms involved are discussed. (C.H.)

9896 ULTRAVIOLET INACTIVATION OF ESCHERICHIA COLI RIBOSOMES. II. EFFECTS OF MESSENGER RNA BINDING ON ULTRAVIOLET SENSITIVITY OF RIBOSOMES. Tokimatsu, H.; Kagawa, H.; Fujutome, H.; Kawade, Y. (Osaka Medical School. Kyoto Univ.). Biochim. Biophys. Acta, 169: 363-72 (Dec. 17, 1968).

The effects of messenger RNA binding on uv-radiosensitivity of Escherichia coli ribosomes were studied. The inactivation rates of the poly-(U)-dependent polyphenylalanine synthesis activity of the 70-S ribosome and isolated 30-S subunit irradiated together with poly (U) or poly (A) became different from those of the ribosomes irradiated without the messenger RNA (mRNA). The effects of poly (U) and poly (A) were different, the former enhancing and the latter decreasing the uv-radiosensitivity of the ribosomes. The inactivation rate of the isolated 50-S subunit was not affected by presence of the mRNA. The lethal uv lesion in the 70-S ribosome resided mainly in the 50-S subunit and the changes of the uv-radiosensitivity of the 70-S ribosome caused by interaction with poly (U) or poly (A) also arose mainly from the 50-S subunit. These results indicate that the mRNA bound on the 70-S ribosome changes the state of the uv-sensitive critical sites not only in the 30-S subunit but also in the partner 50-S subunit. The poly (U)-70-S ribosome association was found to be stable to uv irradiation, whereas the poly (U)-30-S subunit complex was rapidly degraded by uv irradiation, indicating that the state of the mRNA-binding site is different according to whether it is in the 70-S ribosome or in the isolated 30-S subunit. (auth)

9897 RABBIT ERYTHROCYTE PYRIDINNUCLEOTIDES AND NUCLEOSIDASE ACTIVITY AFTER X-RAY IRRADIATION. Ababei, L.; Filip, M. (Inst. of Medical Research, Iasi. Inst. of Medicine, Iasi). Int. J. Radiat. Biol., 14: 235-43(1968).

The effect of x irradiation (600 R) of rabbit erythrocyte NAD and NADP was studied at various intervals after whole-body irradiation of the animal. The decrease found in both pyridinnucleotides progressed with time. The decrease in NAD and NADP was significant after the first hr of irradiation. In the cells of the irradiated animals an increase was found in NAD-ase and NADP-ase activity, that accounts for the decrease in pyridinnucleotide concentrations. Nicotinamide inhibits the activity of enzymes both in normal and irradiated animal erythrocytes. The protective effect of nicotinamide was more marked on the NADP than on the NAD system. (auth)

9898 PROCEEDINGS OF THE FOURTH REHOVOTH CONFERENCE ON HEALTH PROBLEMS IN DEVELOPING STATES, 15–23 AUGUST 1967, JERUSALEM AND REHOVOTH, ISRAEL. Israel J. Med. Sci., 4: 331-773(May-June 1968). (CONF-670842).

Manifold aspects of health in developing countries were discussed in 35 papers presented at the conference. A separate abstract was prepared on one paper. (C.H.)

For an abstract of the individual paper see: 9967.

9899 THE CATALYTIC VERSATILITY OF ERYTHROCYTE CARBONIC ANHYDRASE. VIII. DEUTERIUM SOLVENT ISOTOPE EFFECTS AND APPARENT ACTIVATION PARAMETERS FOR THE ENZYME-CATALYZED HYDROLYSIS OF p-NITROPHENYL ACETATE. Pocker, Y.; Stone, J. T. (Univ. of Washington, Seattle). Biochemistry, 7: 4139-45(Nov. 1968).

The kinetics of the carbonic anhydrase catalyzed hydrolysis of p-nitrophenyl acetate were studied in both H_2O and D_2O at 25.0°. Plots of activity as a function of pD have the sigmoid shape analogous to that obtained in H_2O, but with the inflection at pH 7.5 being displaced to a pD of 8.1. In addition, a second rise in activity occurs at pD >10 that appears to correspond to the initial part of a second titration curve of a deuterio acid of pK_a >10. The value of $k^{H_2O}_{enzyme}/k^{D_2O}_{enzyme}$ corresponding to the ratios of catalytic coefficients k_{enzyme} in H_2O and D_2O, respectively, was around unity. The kinetic effects of D_2O solvent on K_m and on the turnover number k_2, were separated and found to be: $K^{H_2O}_m/K^{D_2O}_m \simeq 0.5$ and $k^{H_2O}_2/k^{D_2O}_2 \simeq 0.75$. The kinetic deuterium isotope effect for the turnover number was almost identical with that obtained for OH^- vs. OD^- attack on p-nitrophenyl acetate. The enzyme-catalyzed hydrolysis of p-nitrophenyl acetate was also investigated at four temperatures ranging from 15.0 to 45.0°. The pH-rate profile was determined at each temperature and the sigmoid curve obtained was found to correspond to the titration of an acid whose pK_a is shifted to lower values with increase in temperature, $\Delta pK_a/\Delta T \simeq -0.02$. Likewise the Michaelis–Menten parameters were determined at several pH values at each temperature. The activation energy for the dissociation of the enzyme–substrate complex, K_{diss}, was found to be 11 kcal/mole. At constant pH, an apparent energy of activation of around 12 kcal/mole was deduced for the breakdown of the enzyme–substrate complex in the region of the first inflection; this value is similar to that found for the hydroxide ion catalyzed hydrolysis of p-nitrophenyl acetate. It was independently shown that the turnover number, k_2, depends upon a group whose heat of ionization is ca. 7 kcal/mole and that the proper energy of activation associated with the breakdown of enzyme–substrate complex is 7.7 kcal/mole. Consistency of the data with the previously proposed reaction pathway is noted. (auth)

9900 OXALOACETATE DECARBOXYLASE FROM COD. CATALYSIS OF HYDROGEN–DEUTERIUM EXCHANGE IN PYRUVATE. Kosicki, G. W. (Harvard Univ., Cambridge, Mass.). Biochemistry, 7: 4310-14(Dec. 1968).

The mechanism for the decarboxylation of oxaloacetate by oxaloacetate decarboxylase proceeds by way of a metal ion-oxaloacetate-enzyme complex through the enol form of pyruvate to the keto form of pyruvate. The reverse reaction should then lead to the enol from the keto form of pyruvate, so that the enzyme in the presence of metal ion should catalyze the exchange of hydrogen atoms of pyruvate with the solvent. This prediction was realized; the rate of the reaction was measured by nuclear magnetic resonance techniques. The catalyzed hydrogen exchange was both metal-ion dependent and inhibited by oxalate, as is the catalyzed decarboxylation of oxaloacetate and the catalyzed $NaBH_4$ reduction of pyruvate. (auth)

Ecology

Refer also to abstracts 9825, 9826, 9842, 9928, 9930, 9941, and 9944.

9901 (AEC-tr-6940) PROBLEMS OF BIOLOGICAL OCEANOGRAPHY. Transactions of the 2nd International Oceanographic Congress held in Moscow, 30 May–9 June 1966. Translation of pp 115-42; 169-226 of Voprosy Biookeanografii. Materialy II Mezhdunarodnogo Okeanograficheskogo Kongressa, 30 Maya–9 Iyunya 1966 g, Moscow, Naukova Dumka, Kiev, 1967. 90p. Dep. CFSTI.

Thirty-one papers discuss various aspects of biological oceanography. Separate abstracts were prepared on five papers. (C.H.)

For abstracts of individual papers see: 9825, 9826, and 9928–9930.

9902 (NP-17646) ANNUAL REPORT, JULY 1965–JUNE 1966. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). Contract 201/R2/RB. 287p. Dep.

Concentrations, uptake, and loss of selected radionuclides by representative organisms in the Adriatic Sea were determined. Investigations of conditions off the West Istrian coast included determinations of meteorological conditions, temperature, salinity, density, transparency, pH, oxygen, and phytoplankton. Radioecological investigations included determinations of radioisotopes in sediments, sea water, and marine organisms. A table is presented to show gross β radioactivity in species of algae, molluscs, echinoderms, and fish. Activities of ^{60}Co, ^{54}Mn, ^{106}Ru, and ^{65}Zn were determined in plankton. Physico-chemical studies of sea water included characterization and separation of ^{106}Ru by electromigration methods, polarographic investigations of cadmium, indium, and zinc, and precipitation and hydrolysis of thorium, zirconium, yttrium, and rare earths. Studies on uptake, concentration, and loss of radioisotopes by marine animals included the following: uptake of ^{56}Co, ^{57}Co, ^{58}Co, ^{54}Mn, and ^{65}Zn by mussels in the presence of EDTA; influence of the physico-chemical forms of ^{106}Ru on its uptake by mussels; uptake of ^{65}Zn by shrimps in the presence of EDTA; metabolism of ^{22}Na in shrimps, mussels, and fishes during acclimation to various salinities; and mechanism of zinc metabolism in mussels. (H.L.W.)

9903 (NYO-2579-18) RADIOECOLOGY OF SMALL VERTEBRATE SPECIES UNDER NATURAL ENVIRONMENTS. Progress Report, December 1, 1967–November 30, 1968. (Pittsburgh Univ., Pa.). Contract AT(30-1)-2579. 28p. Dep. CFSTI.

The ecology of the northern pocket gopher (Thomomys talpoides), the eastern chipmunk (Tamias striatus), and the uinta ground squirrel (Citellus armatus) was investigated in order to find species whose size, habits, and physiological characteristics made them suitable for studies on the effects of radiation on populations under natural conditions. Results of preliminary studies on the effects of sub-lethal doses of γ radiation on individuals and populations of the pocket gopher and chipmunk showed that irradiation had no effect on total population numbers. Animals exposed to doses of 400 R showed graying of the pelage. (C.H.)

9904 (ORNL-4316, pp 71-160) RADIATION ECOLOGY. Auerbach, S. I. (Oak Ridge National Lab., Tenn.).

ANGIOSPERMIDAE — Liriodendron tulipifera, growth of shoots of, cesium-137 tracer study of seasonal variations in
— Liriodendron tulipifera, distribution of rainfall in canopy of, cesium-137 tracer study of
— Juncus Roemerianus, analysis of production and decay rates of, compartmental
ARTHROPODA — Cultroribula juncta, ingestion of pine-mor detritus by, rate of
BETA PARTICLES — effects on life span and pollinating behavior of honey bees
— effects on adults, eggs, and young of Sinella curviseta, determination of LD_{50} and RBE for
— effects on tissues of higher plants, simulated fallout strontium-90
— effects on population dynamics of Collembola, compartmental analysis of
CALCIUM — content of arthropods on forest floor
CARBON DIOXIDES — evolution from forest soils, effects of microbial populations on
— movement to vegetation under field conditions, instrument for aerodynamic measurement of
CESIUM-134 — metabolism in cotton rats, effects of acute or chronic ingestion on
CESIUM-137 — transport in insect food chain, energy kinetics for
— uptake from forest soils by Trichoderma viride in relation to content of organic debris
— metabolism in fescue
— content of fish in White Oak Lake, statistical analysis of
COBALT-60 — uptake and excretion by black bullheads in White Oak Lake
CURIUM-242 — metabolism in plants in relation to transport through food chain to man
ECOSYSTEMS — radioisotope transport in terrestrial microcosmic, cesium-137, manganese-54, and phosphorus-32
— radioisotope uptake by living and nonliving components of aquatic, statistical analysis of cesium-137, cobalt-60, manganese-54, strontium-85, and zinc-65
— analysis of Walker Branch Watershed
— analysis of, compartmental
— phosphorus cycling in Douglas Fir forest, computer simulation of
— nitrogen cycles in dune and grassland, equations for
— computer-based analysis of biomass in grassland
— analysis of components in subarctic blanket bog, compartmental
ENERGY — content of dogwood trees, caloric measurement of
FOOD — preferences among forest centipedes
FOOD CHAINS — energy transport in animal, estimation of
FORESTS — dry weight and mineral content of, computer program for estimating
— analysis of biomass in tropical rain, computer program for
— management of, ORNL program for
GAMMA RADIATION — effects on respiration in crickets in relation to increased survival
— effects on life span and pollinating behavior of honey bees
— effects on adults, eggs, and young of Sinella curviseta, determination of LD_{50} and RBE for
— effects on hatchability of carp eggs following irradiation of fertilized eggs or mature male gametes, acute
— effects on chromosomes of larval and male adult Chironomus riparius, aberrant acute cobalt-60
— effects on cottonwood trees, genetic modification of sensitivity to acute cobalt-60
INSECTA — Acheta domesticus, radioisotope metabolism in, cesium-134, chromium-51, and iodine-131
IRON-59 — effects on hematopoietic system of small mammals, determination of LD_{50} from β and γ
MOLLUSCA — Goniobasis clavaeformis, feeding rate of, cobalt-60 tracer study of
NEUTRONS — effects on life span and pollinating behavior of honey bees
NEUTRONS, FAST — effects on cesium-137 metabolism in cottonwood saplings
— effects on transport of cesium-137 and cobalt-60 in aquatic microcosms, combined effects of biotic complexity on
POTASSIUM — content of arthropods on forest floor
SEASONS — effects on content of dead and living biomass in fields of Andropogon and Fescue
SODIUM — content of arthropods on forest floor
SOILS — populations of invertebrates in forest, effects of pesticides on
TUNGSTEN-187 — uptake and excretion by black bullheads in White Oak Lake
WATER VAPOR — movement from vegetation under field conditions, instrument for aerodynamic measurement of
WHITE OAK LAKE — content of periphyton in, effects of depth on (E.R.B.)

9905 (ORO-3514-7) USE OF RADIOISOTOPES FOR STUDIES ON THE ECOLOGY OF TICK VECTORS OF DISEASE. Period Covered: April 1, 1968–January 1, 1969. Sonenshine, Daniel E. (Old Dominion Coll., Norfolk, Va.). Contract AT-(40-1)-3514. 119p. Dep. CFSTI.

Larvae and nymphs of ticks known to be disease vectors were labeled with radioisotopes and released at various locations for ecological studies. Numerous labeled adults were recaptured and data are presented on the population size, density in relation to vegetative cover, overwinter survival, dispersal, and mammalian hosts of the American dog tick (Dermacentor variabilis), the lone star tick (Amblyomma americanum), Rocky Mountain wood ticks (Dermacentor andersoni), and the rabbit tick (Haemaphysalis leporispalustris). Strontium-90 was most satisfactory radioisotope of several tested for the mass labeling of ticks. (C.H.)

9906 (RLO-1750-28) ECOLOGICAL STUDIES OF RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY AND ADJACENT PACIFIC OCEAN. Progress Report, July 1, 1967–June 30, 1968. Reference 68-7. McCauley, James E. (comp. and ed.) (Oregon State Univ., Corvallis. Dept. of Oceanography). July 1968. Contract AT(45-1)-1750. 327p. Dep. CFSTI.

Progress is reported on studies on the ecology of the Columbia River Estuary and adjacent Pacific Ocean. Radioisotopes introduced into the Columbia River in nuclear wastes from Hanford make many tracer studies of biota and sediments possible. Data are presented on the cycling of ^{60}Co, ^{51}Cr, ^{59}Fe, ^{54}Mn, ^{124}Sb, and ^{65}Zn between marine biota, sediments, and water; the distribution of these radioisotopes and ^{55}Fe, ^{210}Pb, ^{210}Po, ^{125}Sb, and ^{46}Sc in marine food chains and organisms in the Estuary; the feeding and reproductive processes of certain invertebrates; and tracking of the Columbia River Plume in the Pacific Ocean. (C.H.)

9907 (TID-3915) RUSSIAN RADIOECOLOGY, A Bibliography of Soviet Publications with Citations of English Translations and Abstracts. Klement, Alfred W. Jr. (Nevada Operations Operations Office (AEC), Las Vegas); Lytle, Charles F. (Pennsylvania State Univ., University Park. Dept. of Zoology); Schultz, Vincent (Washington State Univ., Pullman. Dept. of Zoology). Sept. 1968. 131p. Dep. CFSTI.

References to 1340 works by Soviet scientists in the direct and indirect interest of radioecology are included. Most of the references are dated after 1955, but the total time period covered is 1916 to 1968. The titles are all translated, and where English translations of the articles are available, that fact is indicated. (C.O.)

9908 (UCLA-12-686, pp 53-66) ENVIRONMENTAL RADIATION. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

The effects of chronic low-level γ irradiation on the ecology of animals and plants were studied at the Nevada Test Site. Data are included on the distribution of arthropods and on the life span and fecundity of natural populations of lizards (Uta and Cnemidophorus). Data on winter annuals were collected for vegetation studies and about 600 vascular plants collected during the period from April to June were processed for use in studies. The response of desert shrubs (Lycium, Franseria, and Grayia) to moisture and temperature, and the growth characteristics of the drought-resistant shrubs Larrea divaricata and Grayia spinosa were studied. Studies on soils included studies on the effects of high fluxes of γ radiation, such as occur during an underground or surface nuclear detonation, on the water solubility of Ca and Sr in soils; the effects of γ radiation on the solubility of Fe-chelates in soils; the uptake of Fe from Fe-chelate solutions by plants; and the effects of Fe deficiency on the uptake of ^{82}Br, ^{45}Ca, ^{137}Cs, ^{86}Rb, and ^{85}Sr by tobacco plants (Nicotiana tabacum). (C.H.)

9909 (UWFL-93(Pt.1)) BIKINI-ENIWETOK STUDIES, 1964. PART I. ECOLOGICAL OBSERVATIONS. Welander, Arthur D.; Bonham, Kelshaw; Donaldson, Lauren R.; Palumbo, Ralph F.; Gessel, Stanley P.; Lowman, Frank G.; Jackson, William B. (Washington Univ., Seattle. Lab. of Radiation Biology). Sept. 15, 1966. Contract AT(45-1)-1385. 277p. Dep. CFSTI.

Nuclear devices were detonated almost every other year at Bikini and Eniwetok Atolls, Marshall Islands, from 1946 through 1958, leaving devastation from blast and fire as well as large amounts of residual radioactivity in the atolls and in the surrounding waters. Results are reported from ecological studies of the atolls made during 1964. Specimens of animals, plants, soils, and seawater were collected for study. Sampling procedures are described. Ecological findings are illustrated by 183 photographs, many of which are in color. (C.H.)

Genetics and Cytogenetics

Refer also to abstracts 9831, 9853, 9854, 10045, 10048, 10108, 10110, 10111, 10118, and 10120.

9910 (EUR-4080) APPLICATION OF ATOMIC ENERGY IN AGRICULTURE. Annual Report, 1967. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands)). 1968. 115p. Dep.

Progress is reported on applications of radiation in agriculture. Radiation was used to increase variability and produce desirable plant mutants for use in breeding programs. Adventitious buds, dormant scions, and growing shoots, bulbs, and tubers of vegetatively propagated plants were exposed to doses of fast neutrons, γ, or x radiation. Results are reported for apples, pears, cherries, carnations, tulips, roses, and potatoes. Seeds or pollen of sexually propagated plants were irradiated and progeny were crossed to improve growth characteristics, yield, and disease resistance. Results are reported for barley, wheat, peas, brussel sprouts, tomatoes, and tobacco. Methods were developed to avoid or reduce chimerism after mutagenic treatment of carnations and potatoes. The influence of biological variables and environmental factors on the effects of radiation on plants, the cytology of irradiated plant parts, and genetic and biochemical changes in plants induced by irradiation were studied. Investigations on the radiation processing of fruits, vegetables, and meats were continued and results are reported on the effects of γ radiation on the storage life and wholesomeness of apples, pears, strawberries, raspberries, dried fruit powders, onions, potatoes, asparagus, beef, poultry, and sea foods. The sterile male technique was investigated for the γ sterilization of the onion fly. The dispersion of radioisotopes in soils and plants was studied, with emphasis on ^{90}Sr. Methods used for the dosimetry of fast neutrons and γ radiation are discussed. A list is included of 65 publications during the period covered by this report. (C.H.)

9911 (NP-17514, pp 87-97) RADIATION CYTOLOGY LABORATORY. Leach, W. M. (National Center for Radiological Health, Rockville, Md.).

Studies on effects of radiation at the cellular level are concerned chiefly with chromosome breakage, chromosome stickiness, mitotic delay, and cell reproductive death. Studies on human cytology included chromosome analysis of patients during treatment for chronic lymphocytic leukemia, studies on probable etiologies of congenitally defective aneuploid humans, and electron microscopy of chromosomes and radioinduced chromosome damage. Studies with hamsters included influence of age on the incidence of chromosomal aberrations in the thyroid, survival of hamsters injected with cultivated spleen and bone marrow cells after x radiation, and radiosensitivity of germinal cells cultivated in Rose chambers. Grasshopper neuroblasts were used for studies on ultraviolet-induced incorporation of tritiated thymidine during prophase and x-ray induced chromosome stickiness. Sensitivity of rat kangaroo cell lines to x radiation was investigated. (H.L.W.)

9912 (NYO-2043-173, pp 3-17) COMPARATIVE STUDIES ON THE MUTATION FREQUENCY AND GENETIC BEHAVIOR OF THE MUTANTS INDUCED BY ACUTE AND CHRONIC GAMMA IRRADIATION AND ETHYL METHANESULFONATE. Moh, C. C.; Nanne, H. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The mutation frequency of the common bean plant, (Phaseolus vulgaris) was determined for three generations, so far, following exposure to cesium-137 γ rays. In one group (acute seed irradiation), dry seeds were exposed to 4, 8, and 12 KR at a dose-rate of 631 R/min. In a second group (chronic plant irradiation), the growing plants received daily doses of 25 to 75 R from a centrally located cesium-source. The frequency of mutations in the R_2 and R_3 generations showed a similar trend between acute and chronic irradiation with many more mutations appearing in the R_3 than the R_2 generation. Of 130 mutants isolated from the acute seed irradiation group, only 41% were chlorophyll abnormalities the remainder morphological; while in the chronic exposure group, of 195 mutants isolated 77% were chlorophyll mutants. In a second, related study, bean seeds were treated with 0.08 M and 0.02 M solutions of ethyl methanesulfonate (EMS) for 6 and 24 hrs, respectively. Results indicated that higher doses (0.08 M) of EMS were more effective than longer treatment times (24 hr) in inducing mutations. Chlorophyll and morphological mutants were induced by EMS in a virtual 1:1 ratio. (E.R.B.)

9913 (NYO-2043-173, pp 38-47) PHYSIOLOGICAL STUDIES ON THE RADIATION-INDUCED DWARF BEAN MUTANT. Greene, G. L.; Proano, V. A.; Morales, C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Radioinduced bean mutants (dwarf) were grown in half-strength Hoagland's number 2 solutions and subjected to 12 hr photoperiods of light of various wave lengths. Bioassays and chromatographic analyses of the various gibberellin fractions indicated that the mutation was the result of a single-gene metabolic block of either gibberellin precursors or of non-acidic fraction gibberellin-L like materials. Results of the studies of the effects of light quality indicated that the gibberellin content of the seeds sustained normal growth in the dwarf mutants until it was exhausted and that

it was replaced in the dwarf mutant only at the time of subsequent seed formation. (E.R.B.)

9914 SOME OBSERVATIONS ON THE INFLUENCE OF X-RAYS ON THE SOMATIC CHROMOSOMES OF URGINEA INDICA KUNTH. Rangaswami Ayyangar, K. (Annamalai Univ., Annamalainagar, India). J. Annamalai Univ., 26: Pt. B, 14-18 (1965).

Young plants of U. indica were irradiated with x rays from a Coolidge tube operated at 45 kVp and 2.4 mA. X rays induced changes in nuclei which were in the process of division, especially in the anaphasic stages. Formation of acentric fragments, dicentric and rings was observed in the irradiated root-tip chromosomes. 10 ref. (Indian Sci. Abstr.)

9915 RED-ROT RESISTANT MUTANT OF SUGARCANE INDUCED BY γ IRRADIATION. Thuljaram Rao, J.; Srinivasan, K. V.; Alexander, K. C. (SugCane Breed. Inst., Coimbatore, India). Proc. Indian Acad. Sci., 64: Sect. B, 224-30(1966).

Sugarcane variety Co. 449 is highly susceptible to strain D of the red-rot pathogen, Glomerella tucumanensis. Plants obtained from vegetative buds exposed to 500, 1000, 2000, 3000, 4000, 5000 and 10,000 R of γ radiation from a ^{60}Co source were inoculated with the D strain. One plant each from the vegetative progeny of buds subjected to dosages of 500 and 3000 R were found to be resistant while all the others (an average of about 1500 for each dosage) were susceptible. The mutant clones were morphologically indistinguishable from the original variety and possessed its other agronomic attributes also. These selections were made from individual inoculation and study of about 65,000 stalks of the sugarcane variety. Both the mutant clones arose from the third bud of the cane arising from the irradiated bud. The interesting fact that mutations almost invariably seem to appear in buds 3 to 7 of the cane arising from the mutation treated bud is believed to be the result of diplontic selection. (24 references). (Indian Sci. Abstr.)

9916 EFFECTS OF RADIATION ON SELECTION PROGRESS IN MICE. Womack, James Ernest. Corvallis, Oreg., Oregon State Univ., 1968. 64p.

Thesis.

The effects of x irradiation on quantitative genetic traits were investigated by comparing the response of irradiated mice to selection for litter size and 28-day weight with the response to selection for the same two traits in non-irradiated lines. Irradiated lines were maintained at three levels of x irradiation, 25 R, 50 R, and 100 R, administered to both males and females immediately before pairing. No matings were made later than 14 days after irradiation so that only the effects of x irradiation upon the post-meiotic stages of gametogenesis were studied. The lines receiving 50 R and 100 R were all lost by the fourth generation of selection. An interaction of genetic and physiological factors was assumed to be responsible for the reduced fertility leading to the termination of these lines. Selection response for litter size was negative in five of the six irradiated lines. This was attributed to reduced selection differentials due to lower fertility and to reduced heritability due to physiological masking of the additive genes for litter size. It appears that the accumulation of recessive lethals also may have played a role in reducing heritability in the irradiated lines. Selection response for 28-day weight was positive in four of the six irradiated lines, although less than in the non-irradiated controls in most cases. Three of the irradiated lines had realized heritability values greater than either of the controls. Some increase in usable genetic variance for 28-day weight was indicated although reduced selection differentials prohibited increased selection response. Irradiation of females in metestrus or one day after metestrus increased the size of their litters. Females mating later than one week after irradiation produced fewer litters and litters of smaller size than control females. Most of the fertility problems encountered in irradiated animals could be attributed to the females. Histological examination eight months post-irradiation revealed serious radiation damage in ovaries while spermatogenesis appeared normal. Females receiving 50 R and 100 R had a significantly higher incidence of mammary gland tumors at ten months of age than the non-irradiated controls. (Dissert Abstr.)

9917 EFFECTS OF IONIZING IRRADIATION ON PARAMUTATION AT THE R LOCUS IN MAIZE. Shih, Katherine Lu. Madison, Wis., Univ. of Wisconsin, 1968. 116p.

Thesis.

The effects of irradiation on paramutation at the R locus in maize were reported. The evidence showed that the pigmenting potential of paramutant (repressed) alleles, $R^{r'}$, $R^{r'''}$, and $R^{r''''}$ was partially restored by X irradiation. Complete restoration, however, occurred only rarely. It appeared that a highly repressed paramutant allele was less sensitive to derepression by X irradiation than a less repressed paramutant allele. It was also shown that paramutation of R^{r} in $R^{r}R^{st}$ heterozygotes was reduced if the paramutagenic R^{st} allele and the paramutable R^{r} allele were X-irradiated at the pollen stage before the heterozygotes were made. If the R^{st} and R^{r} alleles were irradiated at the seed stage with 10,000 R, however, no change appeared either in the paramutagenicity of the R^{st} allele, or in the paramutability of the R^{r} allele. Paramutation of R^{s} was also reduced in $R^{s}/r^{r}(I)$ heterozygotes if the strongly paramutagenic $r^{r}(I)_{5}$ allele was X-irradiated at the seed stage with 14,000 R. Such reduction did not occur, however, in R^{s} heterozygotes carrying the weakly paramutagenic $r^{r}(I)_{3}$ allele. These results suggested that sensitivity to irradiation varies among different paramutagenic alleles. Self-colored (R^{sc}) mutants from R^{st} were generally insensitive to irradiation if treated at the seed stage with 14,000 R. Two X-irradiated mutant R^{sc} stocks were exceptional, however, and showed an increase in paramutagenicity. Additional findings indicated that paramutation of R^{r} was reduced in $R^{r}R^{st}$ heterozygotes after direct X-irradiation of seed with 8,000 R or 10,000 R. Similar results were obtained in $R^{r}R^{sc}_{I12}$ and $R^{s}/r^{r}(I)_{4}$ seed treatments, although in the latter case treatment induced only a small change. X-irradiation of plants affects the degree of paramutation in heterozygotes of R^{r} with R^{st}, R^{sc}_{I10}, and R^{sc}_{I32}. Treatments applied at various stages of tassel development provided evidence that paramutation occurred early in the growth of the tassel. Seemingly, more change occurred in the growth stages preceding meiosis than during meiosis. Paramutation was either enhanced or reduced following X irradiation depending on the stage of plant growth at which the treatment was applied. It appeared that heterozygotes of R with strongly paramutagenic alleles such as R^{st} were more sensitive to X irradiation than heterozygotes of R with weakly paramutagenic alleles such as $r^{r}(I)_{4}$. Also, there was a similarity between the effects of X irradiation and gamma irradiation on paramutation of R^{r} in $R^{r}R^{st}$ plants. All $R^{r'}$ and $R^{r'''}$ alleles whose pigmenting ability was increased by X irradiation were still paramutable. The paramutability of the R^{r} allele and the paramutagenicity of the R^{st} allele were reduced by X irradiation but the alleles were not thereby inactivated. The radioinduced increase in pigmenting ability of paramutant alleles, the reduction in paramutability of standard R alleles, and the reduction in paramutability of the R^{st} allele were gametically transmissible. Likewise, the changes were induced at or near the R locus itself, and not elsewhere in the genome. The nature of the R locus and the mechanism of paramutation were discussed. (auth)

9918 ENHANCEMENT OF THE VIABILITY OF IRRADIATED BACTERIA BY CHROMOSOME TRANSFER. Johansen, Ivar; Ustaheim, Aase (Norwegian Defence Research Establishment, Kjeller). Radiat. Res., 36: 610-21(Dec. 1968).

The effect of x-irradiating recipient cells of Escherichia coli K-12 before mating on the formation of recombinants and on the distribution of parental genetic material among recombinants was investigated in both the wild-type (Rec^{+}) and a recombination-deficient (Rec^{-}) mutant. In crosses involving Rec^{-} recipients, recombinants selected for a late donor marker were formed in almost normal numbers. Rec^{-} cells exposed to otherwise lethal doses of x rays were still able to form viable recombinants for a distal male marker. These recombinants had inherited almost all the transferred donor chromosome, as evidenced by the preponderance of male markers in the recombinants. In contrast, the recombinant-forming ability was about as x-ray-sensitive as the colony-forming ability in Rec^{+} cells. No preference for donor chromosomal material was observed in recombinants from crosses involving x-irradiated Rec^{+} cells. (auth)

9919 RELATIVE EFFECTIVENESS OF FAST NEUTRONS, X-RAYS, AND ETHYL METHANESULFONATE AS MUTAGENS FOR TOMATO POLLEN. Monaco, Lourival Carmo. Davis, Calif., Univ. of California, 1968. 106p.

Thesis.

Experiments were designed to test mutability in the cultivated tomato when pollen was treated with various agents. Four doses of x rays 2.5 to 10 times higher than the corresponding fast neutron doses were applied to tomato pollen. The RBE of neutrons compared to x rays was 12.0 for seed set, 6.3 for seed germination, 5.5 for MF_1 sterility, and 15.0 for recessive gene mutations. The dose-effect relationships ascertained by coefficients of determination for pollen stored and non-stored after x-irradiation and for desiccated pollen treated with neutrons was in most cases nonlinear. The differences from linearity, however, were not large enough to reach statistical significance. Prolongation of the storage period tended to increase the trend toward non-linearity of x-ray treated pollen for seed set, seed germination, and MF_1 sterility. A similar trend was noted when seed set, germination, and MF_1 sterility were compared for the same storage period. Whereas, the dosage effect was linear for seed set, it had a very

important quadratic component for MF_1 sterility. Differential elimination of aberrations might be responsible for such a shift. The frequency of recessive mutations in the MF_2 was linearly related to x-ray and neutron doses. Storage initially increased the mutation rate but for 28 days it resulted in a mutation rate similar to the non-stored samples. Ethyl methanesulfonate was also used as a mutagen for tomato pollen. Concentrations of 25, 50, and 70 mM of the chemical were applied by three methods: dipping branches in the solution, stem notching, and direct immersion of the pollen. The mutagenic effect of the alkylating agent was much lower than that reported for seed. The pollen immersion method proved to be advantageous for the studies of mutation although the rate of mutation was much lower than the rate for radiation. Analysis of individual branches of MF_1 plants suggested that radiation of pollen resulted mostly in whole plant mutations. The results were interpreted in terms of the existing molecular and cytological evidence for occurrence of the mutation process. The present investigations suggest that tomato pollen has attractive features for studies in radiation breeding. However, unless significant improvements are made in techniques, tomato pollen is not as suitable as seeds for study of chemical mutagens. Treatment of seeds with similar concentrations gives much higher mutation rates with similar chimera patterns. (Diss. Abstr.)

9920 MUTATIONAL RESPONSE OF HABROBRACON IN THE BIOSATELLITE II EXPERIMENT. von Borstel, R. C. (Oak Ridge National Lab., Tenn.); Smith, R. H.; Grosch, D. S; (and others). BioScience, 18: 598-601(June 1968).

The biosatellite II Habrobracon experiment was designed to survey mature sperm and all different stages of oogenesis for mutational effects, particularly dominant lethality, recessive lethal, visible mutation frequencies, and inherited partial sterility. The five packages in the spacecraft and in the earth-based controls were placed relative to a ^{85}Sr γ-source so that the Habrobracon would receive exposures of 4000, 2000, 1000, 500, and 0 R. Some Habrobracon were irradiated prior to launch and some were irradiated during flight. For dominant lethality in Habrobracon sperm as the criterion, no interaction effects of γ radiation and space flight were found. When dominant and recessive lethality in Habrobracon oocytes in the first meiotic metaphase was the criterion, a marked enhancing effect of radiation in space flight was found. The late prophase I oocytes were insensitive, but the small prophase I oocytes were similar to metaphase I oocytes in exhibiting an enhancing effect of radiation during space flight. When killing of transitional and primitive oogonia was measured by fecundity, a marked antagonistic effect of radiation by space flight was found. The enhancing and antagonistic effects were observed whether Habrobracon was irradiated before or during the flight, although the effect was greater in Habrobracon irradiated during flight. (BBB)

9921 ISOLATION AND CHARACTERIZATION OF SOME UV-INDUCED MUTANTS OF CHLORELLA VULGARIS PRINGS. Solomon, Mark J.; Crane, Frank A. (Univ. of Illinois, Chicago). J. Pharm. Sci., 57: 2038-44(Dec. 1968).

Clones of new uv-radioinduced mutants of Chlorella vulgaris are reported, including two strains darker green than the wild type. The isolated strains were characterized as to relative uv survival and general mutability. Significant stimulation of growth after low doses of uv irradiation was obtained. A taxonomic criterion distinguishing C. vulgaris and C. pyrenoidosa was recognized. Diameter measurements of cells grown under uniform environmental conditions differentiated C. vulgaris from C. pyrenoidosa, and various mutant clones within an initial isolation. Various histochemical and aberrant cytological features of mutant strains were observed. Thin-layer chromotography of extracted pigments demonstrated several that differed from those of the normal cells. (auth)

9922 NEW CONTRIBUTIONS TO THE STUDY OF SUNFLOWER TREATMENT WITH RAPID AND THERMAL NEUTRONS AND ITS NUTRITION UNDER DIFFERENT HYDRIC AND THERMAL CONDITIONS. Buican, D.; Lupas, V.; Ionescu, Al. Comun. Bot., 5: 99-109(1967). (In Rumanian).

The sunflower crop was favorably affected by treatment with fast and thermal neutrons as evidenced by the modification occurring in the plant size and by the percentage of edible oil extracted. At the same time, obvious morphological changes became apparent, some of which are under study. Physiological analyses (concentration of cell sap, respiration, overall humidity, etc.) revealed that the plant underwent important metabolic changes through irradiation. Phosphorus uptake from fertilizers was closely related to nitrogen and hydric nutrition. The data illustrated the positive influence of nitrogen on phosphorus assimilation, especially when applied rationally, in an atmosphere of increased humidity. The highest phosphorus uptake in younger plants was recorded at about 30°C. The fact that comparatively low temperatures (10°C) did not significantly influence the rate of nutrient assimilation showed that the plant was more or less resistant to frost. The mutative and stimulant effects of irradiation in sunflower crops as well as some important theoretical and practical particularities connected with the nutrition and humidity of this plant are discussed. (Rom. Sci. Abstr.)

9923 MUTAGENESIS AT A COMPLEX LOCUS IN DROSOPHILA WITH THE MONOFUNCTIONAL ALKYLATING AGENT: ETHYL METHANESULFONATE. Jenkins, John Bruner Jr. Los Angeles, Calif., Univ. of California, 1968. 76p.

Thesis.

Ethyl methanesulfonate (EMS) is a potent mutagenic agent in Drosophila, capable of inducing mutations at the dumpy locus with a frequency approximating four percent. Mutations were found in the progeny of males, both after feeding and after injection with EMS; however, fed males yielded considerably more mutations than injected males. The induced mutation frequency was proportional to the concentration of the EMS injected, which varied from 5mM to 40mM. EMS acted primarily as a mutagen on postmeiotic sperm; the premeiotic and meiotic cells remaining relatively immune to its mutagenic action; however, EMS had a pronounced toxic effect on sperm from the early postmeiotic, meiotic, and early premeiotic broods, as reflected in the depressed progeny production in these broods. EMS was also weakly mutagenic in females and thus a total physiological or cytoplasmic barrier to EMS mutagenesis does not exist. Ninety-eight percent of all the induced mutants detected in the F_1 and F_2 were mosaic (fractional mutants bearing mutant and nonmutant tissue). No depression in the frequency of mosaic dumpy mutants occurred at high molarities, although such a depression occurred with respect to the sex-linked lethal system; the resolution of this paradox is explained. Thirty-five percent of all the F_1 mutants contained mutant tissue in their gonads; the average amount of mutant tissue in a mosaic gonad was about 50%, although the range varied from 2% to 96% in a uniform fashion. For only 23% of the transmitted EMS mutations was there a disagreement in the classification of the phenotype found in the F_2 compared to the F_1. In virtually every such instance of disagreement, the phenotype was less severe in the F_1 than in the F_2. A quantitative measure of this phenomenon, called phenotypic fidelity, is presented. The dissertation concludes with a comparative study of the transmitting dumpy mutants induced with EMS, nitrosomethylurea, x rays, and ICR-170. A model of the dumpy region may be constructed from the frequencies of the induced allelic mutants. (Disser. Abstr.)

9924 SENSITIVITY TO METHYLMETHANESULFONATE AND NITROUS ACID OF ULTRAVIOLET LIGHT-SENSITIVE MUTANTS IN SACCHAROMYCES CEREVISIAE. Zimmermann, F. K. (Univ., Freiburg i. B.). Mol. Gen. Genet., 102: 247-56(Oct. 10, 1968).

Twenty-two uv-radiosensitive mutants were tested for a possible cross-sensitivity to nitrous acid and methylmethanesulfonate. Eighteen of these mutants showed, in comparison to wild type, an increased sensitivity to methylmethanesulfonate and 16 mutants were cross-sensitive to nitrous acid. Cross-sensitivity between these two chemicals was good even when the degrees of sensitivity were compared; only two major exceptions were found. The degree of sensitivity to the two chemicals on one side and to uv light was not always the same. Two mutants of extreme sensitivity to chemicals were only weakly sensitive to uv light whereas in another mutant an extreme sensitivity to uv light was combined with a low sensitivity to chemicals. These observations are discussed in the light of current views on excision repair models. (auth)

9925 CORRECTION OF MOLECULAR HETEROZYGOTES IN THE COURSE OF TRANSFORMATION. Bresler, S. E.; Kreneva, R. A.; Kushev, V. V. (Inst. of High Molecular Weight Compounds, Leningrad). Mol. Gen. Genet., 102: 257-68(Oct. 10, 1968).

A method of clonal analysis of transformed cells was developed. This involves growing of cells on nonselective plates, replication of colonies on selective agar to score for recombinants, homogenization of initial colonies, and their analysis for pure or mixed progeny. Results indicate that pure clones are formed with a probability dependent on the specificity of the mutation involved. Proof is given that the pure clones are the result of the repair of molecular heterozygotes formed during transformation. Clonal analysis of double transformants gave an approach to the study of independent or simultaneous correction of molecular hets. Experiment shows in case of linked markers that simultaneous repair is overwhelming. When the distance between the markers becomes big enough we find a transition to independent correction of hets. The data are in general agreement with results on transformation of Pneumococcus. (auth)

9926 THE ACTION OF NITROSOGUANIDINE AND OTHER DNA-INACTIVATING AGENTS ON STREPTOCOCCUS PYOGENES K 56 STRAINS WITH NORMAL AND REDUCED DARK REPAIR ABILITY. Malke, Horst (Institut fuer Mikrobiologie und Experimentelle Therapie, Jena, Ger.). Mol. Gen. Genet., 102: 241-6(Oct. 10, 1968).

The response pattern for uv light, nitrogen mustard, and EMS of Hcr^+ and Hcr^- strains of Streptococcus pyogenes K 56 was similar to that observed for analogous strains of E. coli, whereas repair-apt streptococcal strains were much more sensitive to nitrosoguanidine and mitomycin C than E. coli. The uvr gene(s) appear(s) to be without effect upon survival, prophage induction, and mutation to streptomycin resistance caused by nitrosoguanidine and only of little influence on repair of mitomycin C damage. (auth)

9927 COMMENT ON THE DIFFERENCE IN SENSITIVITY TO VARIOUS MUTAGENS SHOWN BY CERTAIN MUTANTS. Cox, B. S. (Botany School, Oxford). Mol. Gen. Genet., 102: 256 (Oct. 10, 1968).

It is thought that some mutants are cross-sensitive because they affect an enzyme in a DNA repair pathway and yet show drastic differences in cross-sensitivity. An explanation is presented, based on the observation that the final slopes of some sensitive mutants are similar to the slope of the low-dose shoulder portion of the standard uv curve. (H.L.W.)

Health Physics and Safety

Refer also to abstracts 9512, 9653, 9681, 9694, 9712, 9721, 9722, 9752, 9759, 9767, 9833, 9849, 9902, 9909, 9910, 10097, 10103, 10105, 10106, 10151, and 10875.

9928 (AEC-tr-6940, pp 59-70) ARTIFICIAL RADIOACTIVITY OF MARINE ORGANISMS IN VARIOUS SEAS AND OCEANS. Parchevskii, V. P. Translated from pp 198-209 of Voprosy Biookeanografii. Materialy II Mezhdunarodnogo Okeanograficheskogo Kongressa, 30 Maya-9 Iyunya 1966 g, Moscow, Naukova Dumka, Kiev, 1967.

Data are presented on the content of ^{90}Sr in certain brown and green algae, mollusks, crustaceans, and fish of the Black Sea and the Atlantic and Indian Oceans during the period from 1961 to 1965. A comparison with data on the ^{90}Sr content of organisms in the Pacific Ocean and Adriatic, Ligurian, and Irish Seas indicated that the geographical distribution of ^{90}Sr in the world ocean is extremely irregular. (C.H.)

9929 (AEC-tr-6940, pp 71-9) DISTRIBUTION OF RADIOACTIVE SUBSTANCES IN MARINE ORGANISMS AND THEIR BIOCENOSES. Zesenko, A. Ya. Translated from pp 210-18 of Voprosy Biookeanografii. Materialy II Mezhdunarodnogo Okeanograficheskogo Kongressa, 30 Maya-9 Iyunya 1966 g, Moscow, Naukova Dumka, Kiev, 1967.

The distribution of radioisotopes in marine organisms was studied, with emphasis on the role of mollusks in the transport of fallout in the sea. Data are included from aquarium studies on the distribution of ^{110}Ag, ^{144}Ce, ^{137}Cs, ^{95}Nb, ^{106}Ru, ^{35}S, ^{90}Sr, ^{91}Y, and ^{65}Zn, and ^{95}Zr in various tissues of crabs, Carcinus maenas, and mollusks, Mytilus galloprovincialis. Emphasis was placed on factors influencing the accumulation of ^{106}Ru and ^{95}Zr in crabs and mollusks. (C.H.)

9930 (AEC-tr-6940, pp 80-7) COMPARATIVE INVESTIGATION OF SORPTION AND DESORPTION OF VARIOUS RADIONUCLIDES BY MARINE SHALLOW-WATER SOILS. Baranova, D. D. Translated from pp 219-26 of Voprosy Biookeanografii. Materialy II Mezhdunarodnogo Okeanograficheskogo Kongressa, 30 Maya-9 Iyunya 1966 g, Moscow, Naukova Dumka, Kiev, 1967.

The role of certain Black Sea soils in the distribution of ^{144}Ce, ^{137}Cs, ^{106}Ru, ^{90}Sr, ^{91}Y, and ^{95}Zr was investigated. Sorption factors were determined for samples of soil collected at various locations. The samples included shell rock, sand, and aleuritic and phaseolinic sediments. The highest content of radioisotopes was found in sediments containing shells of mollusks. (C.H.)

9931 (JPRS-44356, pp 65-75) DEVELOPMENT OF DOMESTIC RADIATION HYGIENE DURING THE YEARS OF SOVIET POWER. Moiseytsev, P. I. Translated from Med. Radiol., 12: No. 11, 65-72(1967).

Developments in radiation protection in the U.S.S.R. since 1900 are reviewed, with emphasis on developments since 1945. Monitoring programs and the development of dosimeters are discussed. (C.H.)

9932 (JPRS-44356, pp 76-85) STAGES OF DEVELOPMENT OF CLINICAL DOSIMETRY IN THE USSR. Krongauz, A. N. Translated from Med. Radiol., 12: No. 11, 73-9(1967).

Developments in radiation dosimetry during medical uses of radiation in the U.S.S.R. since 1895 are reviewed. Emphasis is placed on the development of dosimeters for use during radiation therapy. (C.H.)

9933 (MORP-68-6) PRELIMINARY RESULTS OF 5263 X-RAY PROTECTION SURVEYS OF FACILITIES WITH MEDICAL X-RAY EQUIPMENT (1962-1967). Fess, Lawrence R.; Seabron, LaVert C. (National Center for Radiological Health, Rockville, Md.). Apr. 1968; Revised Sept. 1968. 29p.

The results of 5263 x-ray protection surveys performed in 25 states and two territories during 1962 to 1967 are discussed. Included in the report are a profile of an average medical diagnostic x-ray facility and 17 tables of facility, radiographic, and fluoroscopic data. (auth)

9934 (MORP-68-7) REVIEW AND ANALYSIS OF RADIUM INCIDENTS. Robinson, Earl W.; Villforth, John C.; Wold, Gary J. (National Center for Radiological Health, Rockville, Md.). Sept. 1968. 13p.

The National Center for Radiological Health collected and analyzed 396 radium incident reports as of January 1, 1968. A compilation of incident information is presented, together with recommended preventive measures. Most of the reported incidents involved the loss of sealed sources from medical facilities. These losses occurred primarily during irradiation of patients or during removal of the radium from the patient. Fifty-four percent of the recoveries of radium lost from medical facilities occurred in trash systems. No recovery was made in 31 percent of all radium losses and thefts. Sudden source rapture, that resulted primarily from careless handling of sources, accounted for 61 percent of all contamination incidents. A chronological listing of radium incident reports indicates a nearly continuous increase in the frequency of incidents. This may reflect both the increasing use of radium up to the 1950's and the increased likelihood of incidents being reported to health agencies within the last few years. (auth)

9935 (MORP-68-8) DENTAL X-RAY TEACHING AND TRAINING REPLICA. Jameson, Wayne R.; Alcox, Ray W. (National Center for Radiological Health, Rockville, Md.). Sept. 1968. 8p.

The development of a phantom of the human head for use in teaching radiographic procedures in dental schools and schools of dental hygiene and assisting is discussed. The phantom consists of a human skull with polyurethane foam flesh and latex skin and tongue. A mechanical arm and finger are provided to hold dental x-ray films. The entire assembly hooks over the back of a dental chair and has a mandible that can be opened, closed, or locked in any position. The use of this phantom will improve dental x-ray teaching programs while eliminating human exposure. (C.H.)

9936 (NP-17694) ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND AND RESULTS OF EXTENDED MONITORING OF FALLOUT FROM FRENCH NUCLEAR TESTS IN THE PACIFIC. Quarterly Report, April-June 1968. (National Radiation Lab., Christchurch (New Zealand)). 24p. (NRL-F-30). Dep.

Data are presented on the total β activity in rainwater samples and the content of ^{137}Cs, ^{90}Sr, and ^{131}I in milk samples collected in New Zealand during the second half of 1968. Samples of atmospheric particulates, rainwater, and milk collected at a number of South Pacific Islands following the French nuclear tests were analyzed for total β activity. (C.H.)

9937 (NYO-2181-5(Vol.1)) EPIDEMIOLOGICAL FOLLOW-UP OF THE NEW JERSEY RADIUM CASES. Final Report, November 1957-June 1967. (New Jersey State Dept. of Health, West Orange. Radium Research Project). July 1968. Contract AT(30-1)-2181. 613p. Dep. CFSTI.

A 10 yr retrospective-prospective field epidemiological study is described of individuals employed in the early years of the radium dial painting industry in northern New Jersey. Clinical, dental, roentgenographic, clinical laboratory, radiochemical, histologic and other biomedical, and dosimetric data are reported and preliminary evaluation of radition dose-biomedical effects relations are described. Résumés on cases with known body burdens and on controls are presented in an accompanying volume. (auth)

9938 (ORNL-4316) HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1968. (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 324p. Dep. CFSTI.

Separate abstracts were prepared for the 5 included sections. (M.O.W.)

For abstracts of individual sections see: 9681, 9904, 9939, 9940, and 10432.

9939 (ORNL-4316, pp 231-69) RADIATION DOSIMETRY RESEARCH. Auxier, J. A. (Oak Ridge National Lab., Tenn.).

ACCIDENTS—gamma and neutron dosimetry intercomparison for nuclear
HENRE OPERATION—gamma and neutron air dose distribution measurements during
IRRADIATION FACILITIES—radiation dosimetry at UT-AEC Agriculture Research Laboratory variable dose-rate
NEUTRONS—reactions with phantoms at 15.09 MeV, calculation of spectra of recoil heavy particles from
NUCLEAR WEAPONS—yields of, exploded over Hiroshima and Nagasaki
—blast and thermal effects of, at Hiroshima and Nagasaki
—human mortality and injury as result of, over Hiroshima and Nagasaki
ORNL FAST BREEDER REACTOR—operation of
PHANTOMS—neutron reactions at 15.09 MeV, calculation of spectra of recoil heavy particles from
PHOSPHORS—evaluation of organic, for gamma and neutron dosimetry
RADIATION DETECTORS—description of solid-state track alpha, for personnel monitoring of radon and radon daughters
—particle track overlapping in solid-state, probability of
—particle track formation in plastic, chemical processes involved in latent
RADIATION DETECTORS—sensitivity of organic solid-state track, effects of oxygen and humidity on
—use of organic polymer solid-state track, for fast neutron dosimetry
RADIATION DOSIMETERS—development based on thermally stimulated exoelectron emission
RADIATION DOSIMETERS, PHOTOLUMINESCENT—description of lithium borate glass
—linear energy transfer effects in
RADIATION DOSIMETRY—program of Atomic Bomb Casualty Commission in Japan for survivors of Hiroshima and Nagasaki
X RADIATION—hazards associated with vacuum electrical components (B.G.D.)

9940 (ORNL-4316, pp 271-94) INTERNAL DOSIMETRY. Snyder, W. S. (Oak Ridge National Lab., Tenn.).

ALPHA PARTICLES—dose to respiratory tissues following inhalation of plutonium-238-oxides, use of phantoms to determine effects of particle size on
GAMMA RADIATION—dose to human organs from uniform internal source, use of phantoms for computer calculation of effects of organ density and structure on
—dose to man from contaminated food, computer-based calculation of cesium-137
PLUTONIUM-239—content of human body following wound contamination, computer-based analysis of
RADIOISOTOPES—retention time in human organs, computer calculation of
—content of gastrointestinal tract following ingestion, development of mathematical model for calculating activity from
SULFUR DIOXIDES—interactions with airborne particulates, sulfur-35 tracer study of gaseous (E.R.B.)

9941 (ORO-661, pp 77-102) SOIL CHEMISTRY. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

BENTONITES—ion exchange equilibria studies for alkaline earth cations on Wyoming
SODIUM IODIDES—diffusion in non-ideal systems in relations to fission product transport in soil, equations for
STRONTIUM IODIDES—diffusion in non-ideal systems in relations to fission product transport in soil, equations for
VERMICULITES—sodium exchange and sorption on, effects of lattice spacing on (E.R.B.)

9942 (SWRHL-32r) FINAL REPORT OF OFF-SITE SURVEILLANCE FOR THE NRX-A5 TEST SERIES. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Oct. 15, 1968. 45p. Dep. CFSTI.

The Southwestern Radiological Health Laboratory provided off-site radiological surveillance for the NRX-A5 Project Rover Reactor Test Series at NRDS, Test Cell A. During the period in which this series was conducted, there were four experimental plans (EP's) in the NRX-A5 series, two of which were full power runs (1100 Mw) of about 15 minutes duration which produced detectable amounts of radioactivity off-site. Radioactive effluent released by the EP-III on June 8, 1966, was detected by ground level surveillance in the southwest off-site quadrant. Effluent released by the EP-IV on June 23 was detected by ground level surveillance along an azimuth of about 30° (20° cloud width) to the Utah–Nevada border, about 190 miles from the Test Cell. Although off-site contamination occurred from the NRX-A5 test series, surveillance indicated that radioactivity levels did not exceed the radiation protection guides established by the Atomic Energy Commission (AEC Manual Chapter 0524) for the off-site population (based on the Federal Radiation Council Guidelines). The peak potential thyroid dose, for a child with a 2 gram thyroid, in the off-site area from this series was about 20 millirad or less and the external whole body exposure about 1 mR (at different locations). (auth)

9943 (UH-235-P-5-3, pp 155-8) CALIBRATION OF LOW-DOSE IRRADIATION TUBE. Upadhya, Mahesh D.; Ohinata, Kiichi (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

The dose distribution patterns in the central chamber and the 3'' wet irradiation tubes of the Hawaii Research Irradiator (HRI) were reported earlier (Upadhya and Ohinata, 1965, 1966). Calibration of the dry low-dose γ irradiation tube was completed and the data are reported. (auth)

9944 (UWFL-93(Pt.2)) BIKINI-ENIWETOK STUDIES, 1964. PART II. RADIOBIOLOGICAL STUDIES. Welander, Arthur D.; Bonham, Kelshaw; Palumbo, Ralph F.; Gessel, Stanley P.; Lowman, Frank G.; Jackson, William B.; McClin, Raul; Lewis, Gary B. (Washington Univ., Seattle. Lab. of Radiation Biology). Sept. 8, 1967. Contract AT(45-1)-1385. 233p. Dep. CFSTI.

Samples of algae, birds, fish, invertebrates, plankton, plants, vertebrates, sediments, and water collected during 1964 at Bikini and Eniwetok Atolls were analyzed for radioisotope content. Fifteen radionuclides were found in the samples. These included ^{207}Bi, ^{144}Ce, ^{57}Co, ^{60}Co, ^{137}Cs, ^{54}Mn, ^{106}Ru, and ^{125}Sb, plus trace amounts of seven other radionuclides. Data are tabulated on the content of each radionuclide in the biota and the environment. (C.H.)

9945 ESTIMATION OF INTERNAL CONTAMINATION WITH PLUTONIUM BY PHYSICO-CHEMICAL ANALYSIS OF EXCRETA. Dulcino, J.; Koch, G. (CEN, Mol, Belg.). J. Belge Radiol., 51: 284-90(1968). (In French).

In the case of a person internally contaminated by plutonium, the direct measurement of the activity is not usually sufficient to estimate the body burden. On the other hand, excreta measurements allow activities corresponding to lower body burdens to be assessed. The general principles of various types of analyses and the techniques in use are described. (auth)

9946 MEASUREMENT OF THE DOSE OF NEUTRON RADIATION IN TREATMENT WITH THE AID OF LINEAR ACCELERATOR AND BETATRON. Bochkov, N. P.; Sevan'kaev, A. V.; Timofeev-Resovskii, N. V. (Inst. of Medical Radiology, Moscow). Med. Radiol., 13: No. 11, 70-1(Nov. 1968). (In Russian).

Results of neutron dose measurements are reported and definition is made of their contribution to a total dose received by a patient when treated by irradiation emitted by a linear electron accelerator and a Siemens 42 MeV betatron for the therapy of malignant tumors. A method of detection with indium foil was employed for dosimetry. Neutrons were moderated in a polyethylene cylinder 30 cm across. (auth) (CO)

9947 INTERCOMPARISON OF ABSORBED DOSE IN ^{60}Co TELETHERAPY USING MAILED LiF DOSIMETERS. Pfalzner, P. M.; Alvarez, S. Malo (International Atomic Energy Agency, Vienna). Acta Radiol., Ther., Phys., Biol., 7: 379-88(Oct. 1968).

A procedure established by the IAEA for absorbed-dose intercomparison in ^{60}Co γ teletherapy was tested with the cooperation of 19 radiotherapy centers in 6 countries. A series of dosimeter capsules containing LiF powder was distributed by mail and, after irradiation to an absorbed dose of 500 rad at a depth of 5 cm in water, were returned to the IAEA for read-out and evaluation. The results permit conclusions to be drawn concerning the reliability of the method of intercomparison, and provide an indication of the consistency and range of disagreement existing in both absorbed-dose determination and exposure calibration. Root-mean-square deviations of respectively ±1.4% and ±1.8% were found for the readings of irradiated control capsules and test capsules. The maximum differences between institutes in absorbed-dose and exposure determination were respectively 15% and 9%. (auth)

9948 STANDARDISATION OF FIELD-SIZE SPECIFICATION IN MEGAVOLTAGE RADIOTHERAPY. Karzmark, C. J.; Sampiere, V. A.; Stovall, Marilyn (Univ. of Texas, Austin. Anderson Hospital and Tumor Inst., Houston, Texas). Brit. J. Radiol., 41: 712-13(Sept. 1968).

Various conventions for specifying field size were used by different treatment centers, and this increased the likelihood of dosimetric error in radiotherapy. The need for the standardiza-

tion of field-size specifications was stressed because of the increasing use of computers for treatment planning, in order to avoid errors when dosimetric data were exchanged between institutions and for the comparison of treatment techniques for clinical trials. Some of the problems in the use of megavoltage x-ray beams and ^{137}Cs and ^{60}Co teletherapy are outlined and suggestions are made for relating the geometric to the dosimetric field size. (F.M.M.)

9949 GENERAL CONSIDERATIONS ON PREVENTION OF CRITICAL ACCIDENTS. Penelle, G. (CEN, Mol, Belg.). J. Belge Radiol., 51: 291-6(1968). (In French).

The physical phenomena causing a critical state in a fissile environment is reviewed and the various factors which can be used to avoid the occurrence of criticality are discussed. Practical problems facing the person in charge of security in the use of fissile materials are considered. (auth)

9950 DOSE TO ORGANS OF THE HEAD FROM THE X-RAY TREATMENT OF TINEA CAPITIS. Schulz, Robert J.; Albert, Roy E. Arch. Environ. Health, 17: 935-50(Dec. 1968).

Doses to the organs of the head associated with the Adamson-Keinbock x ray epilation treatment for tinea capitis were measured in a tissue equivalent phantom. Doses to the scalp ranged between 450 and 850 rad. Doses to the brain, which were smaller because of shielding by the cranium, ranged between 70 and 175 rad. The eye received 40 to 50 rad and the internal ear received about 70 rad. With the aid of microdosimeters, the dose to cranial marrow was estimated as high as 435 rad. In order to estimate the range of doses received by children of different age groups and head size, a method of calculating scalp and brain doses using a digital computer was developed. (auth)

9951 RADIOLOGICAL SURVEY OF DIAGNOSTIC X-RAY EQUIPMENT. Jones, D. E. A. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Radiol., 41: 833-6(Nov. 1968).

The recommendations regarding routine x ray environmental surveys, and the regular checking of equipment for radiation leakage (Code of Practice, Her Majesty's Stationery Office, 1964), are phrased as desirable but not essential requirements. Evidence derived from a preliminary survey of diagnostic units has indicated that a small proportion of tube systems may not reach the prescribed safety standards. The routine monitoring of x-ray personnel cannot, in the author's opinion, be regarded as an adequate means of complying with these recommendations; indeed, the recording of an exposure on a film badge may well indicate a lapse in the wearer's standard of safety precaution and not a fault in the equipment concerned. The methods available for x-ray tube monitoring and their relative merits are discussed. A commercial light-weight battery-powered counting rate meter connected to a specially modified G.M. tube is recommended. It can show in a few minutes whether a tube which can be operated under fluoroscopic conditions satisfies the radiological safety standards. Recent tests of three equipments showing excessive leakage are described; these cases demonstrate the inadequacy of film badges as environmental monitors. Attention is drawn to an implied ambiguity in the Code of Practice in that no distinction is made between a narrow and a wide beam of leakage radiation, and on radiobiological grounds it is suggested that maximum exposure levels should be expressed in terms of $mR.cm^2$ for such radiation. (auth)

9952 RECHTLICHE PROBLEME BEI STRAHLENSCHAEDEN UNTER BESONDERER BERUECKSICHTIGUNG DER GESETZLICHEN UNFALLVERSICHERUNG. (Legal Problems in Radiation Injuries with Special Regard to Lawful Accident Insurance). Cartellieri, Ulrich. Bonn, Herausgegeben vom Deutschen Atomforum e.V., 1967. 157p.

The legal problems in radiation injuries, especially in regard to accident insurance for occupationally exposed persons, are examined in detail. Radiation sources and possible injuries are described from the legal viewpoint and the legal qualifications of radiation injury are defined. The system of legal accident insurance for occupational radiation injury, radiation injury with respect to the accident insurance law, documentary problems in occupational radiation injury, possible solutions within the framework of the current laws, introduction of a legal causality assumption, and legal bases of the causality assumption are discussed within the framework of the German laws and compared with foreign laws. (J.S.R.)

9953 RADIATION FACTORS IN THE PRODUCTION AND USE OF KRYPTON AND XENON. Vershinin, N. V.; Firsov, V. I.; Mashko, V. E. (Inst. of Occupational Hygiene and Occupational Diseases, Moscow). Gig. Tr. Prof. Zabol., 11: 42-4(Apr. 1967). (In Russian).

Measurements were taken and safety rules suggested as a result of inspection of a Kr–Xe production plant to ascertain from the ambient γ-ray doses the extent of radiation hazards caused by disintegration of the following by-products present in fresh Kr mixtures: Rn, Ra B, and Ra C. It was found that in installations where compressed Kr cylinders were filled, the dose rate to personnel was 0.054 mR/hr; in gasification processes, 0.014 mR/hr; in furnace rooms where O_2 was burned out, 0.013 mR/hr; in the low pressure gas tank area, 0.01 mR/hr; and in the compressor section, 0.01 mR/hr. The highest level of γ radiation (0.13 to 0.15 mR/hr) was recorded on the surface of a rectification column and on the surface of a gas generator (0.29 to 0.36 mR/hr); however, nowhere in the plant did the radiation level exceed the maximum permissible concentration of 10 mR per 25-hr week. The inspection findings indicated that in plant buildings to prevent air contamination by Rn during a large-scale production and handling of Kr, four protective measures could be recommended: Kr-filled cylinders should be kept for 10 to 15 days prior to shipment to customers; within this time Rn concentration would be reduced $1/6$ to $1/15$. Scheduled procedures should be maintained for a successive five-cycle air ventilation of the premises where low pressure gas tanks were used, in dessication areas, in the main control room, and in places where freshly filled cylinders of Kr were stored. Checking and safeguarding airtight connections and capacity ratios of Kr cylinders were necessary. It was advisable to maintain a limited quantity of freshly filled cylinders of Kr, not to ship them or store them too soon, and to keep such material at a safe distance from permanent working areas. (BBB)

9954 DOSE GRADIENT VECTORS IN 4 MV X-RAY TREATMENT PLANNING. Hamilton, Margaret D.; Laurie, Jean; Orr, J. S. (Western Regional Hospital Board, Glasgow). Brit. J. Radiol., 41: 687-91(Sept. 1968).

Isogradient charts and their derivation are illustrated and explained for plain and wedged fields. The magnitude of the dose gradient vector was expressed as the change of the percentage of incident dose per centimetre in the direction of maximum local gradient. A graphical method of using isogradient charts was described which facilitated the determination of all the field details necessary for a satisfactory treatment plan. Oblique incidence was treated by additional vectors whose magnitude could easily be found from a graph. Uniformity was approached by minimizing the resultant dose gradient vector. Work on computer optimization of treatment planning showed that the use of such vectors led to satisfactory results. An example of the optimizing of a three-field bladder treatment using vectors was discussed. It was shown that, for the criteria of uniformity, subcutaneous dose and integral dose, the optimum was achieved by using posterior oblique wedged fields which allowed approximately equal incident doses to all fields. A simple method of selecting the appropriate wedge angle was given. (auth)

9955 FAST NEUTRON DOSIMETRY OF ^{252}Cf. Oliver, George Davis Jr. Norman, Okla., Univ. of Oklahoma, 1968. 82p. Thesis.

The fast neutron dose distribution was established around a cell-loaded, radium-type, needle containing 4.5 μg of ^{252}Cf. Measurements were made in a tissue-equivalent phantom, simulating in vivo exposure conditions. The neutron dose rate, measured radially from the needle mid-point, dropped a factor of 100 in the region from 0.5 cm to about 4.5 cm depth. Compared with a milligram of radium, the depth dose curve from a μg of ^{252}Cf dropped off twice as fast. The neutron curve followed the expected mathematical model, according to a combination exponential and $1/r$ fit, with 99.25% correlation. The neutron dose distribution of dose rate in a plane around the needle was presented as an isodose chart. The isodose curves showed symmetrical distribution of dose rate along the needle. As r was increased, the contours approached a circular form. Two dosimetry systems, semiconductor neutron dosimeters and activation threshold materials, were calibrated and used to measure the fast neutron fluence rate, that was mathematically converted to physical dose rate. Compact size, easy read-out, simplicity, and good precision made the semiconductor dosimeters more advantageous than the activation materials. Both systems agreed well for the depth dose curve. Only the convenient semiconductor system was chosen to determine the isodose curves. From the point of view of dose distribution and quality of radiation, ^{252}Cf is a good substitute for radium and other implantable γ-ray sources. (auth)

9956 ^{90}Sr AND ^{137}Cs CONCENTRATIONS IN IMPORTED FOODS. 3. Ikebuchi, Hideharu; Kametani, Katsuaki (National Inst. of Hygienic Science, Tokyo). Eisei Shikenjo Hokoku, No. 85, 145-7(Dec. 1967). (In Japanese).

Strontium-90 and ^{137}Cs concentrations in imported dried milk produced during Feb, 1965, to July, 1966, were tested. Average concentrations of ^{90}Sr and ^{137}Cs in imported dried milk (43 samples) were 14.1 pCi/100 g and 58.0 pCi/100 g, and these values were lower than concentrations found in some domestic dried milk which was produced in the same period. (NSA of Japan)

9957 CRITICALITY ASPECTS AT EUROCHEMIC. Boesch, T.; Hunzinger, W.; Oszuszky, F. (Eurochemic, Mol, Belg.). J. Belge Radiol., 51: 297-301(1968).

The prevention of criticality accidents in the particular case of irradiated fuel reprocessing plants is considered. The Eurochemi Plant at Mol is described and the precautions taken both for avoiding the occurrence of a critical state and for reducing the direct radiation doses to which the staff is exposed are explained. (auth)

9958 PROTECTION RACKET. Stevens, K. A. (Dept. of Health, Brisbane). Radiographer, 14: 19-22(Dec. 1967).

Factors that affect the control and safe handling of x-ray equipment and radioisotopes are discussed from the viewpoint of the health physicist. With x rays the most important considerations are the operating factors of equipment, protective barriers, distance, and safety standards of the equipment itself. With respect to radioactive substances, important factors are the type of radioactive substance (energy and type of radiation emitted), activity of the source, workload, distance, and protective barriers. The amount of radioactivity taken into the body depends on the activity of the substance, its physical state (liquid, gas, or powder), concentration, methods and time of handling, personnel hygiene, protective barriers, and laboratory design. The level of exposure from intake of radioactive substances into the body depends on the type and energy of radiation emitted, the solubility and physical form of the material ingested or inhaled, and the characteristics of the radioactive substance at a biological level. Potentially, internal irradiation poses the greatest problems. It is not subject to easy personnel monitoring as is external irradiation. A sealed source of 1 μCi of Ra can be handled with little risk, but if this amount were incorporated into the body it would exceed the maximum permissible body burden. In the use of unsealed radioactive sources, good radiation hygiene results from having an adequate laboratory, enforcing of adequate working rules, and insistence on high standards of hygiene. (BBB)

9959 A GRAPHICAL METHOD FOR THE PRODUCTION OF ISODOSE CURVES FROM CENTRAL AXIS AND TRANSVERSE DATA. Naylor, G. P.; Ormsby, P. L. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Brit. J. Radiol., 41: 829-32(Nov. 1968).

A rapid and accurate method of isodose curve construction, applicable to both flat and wedged fields for all energies and types of radiation normally used in radiotherapy, has been devised. An account is given of the theory of the method which graphically combines decrement line patterns with depth dose data. The practical application of the method to radiation for a 4 MeV linear accelerator is outlined and a simple plotting table used to facilitate the method is described. (auth)

9960 DECONTAMINATION OF RI PROTECTIVE CLOTHING BY FULL AUTOMATIC CLOSED SYSTEM LAUNDRY CLEANING MACHINE. Yasunaka, Hideo; Ashikagaya, Yoshinobu (Japan Atomic Energy Research Inst., Tokyo). Hoken Butsuri, 3: 348-51(Sept, 1968). (In Japanese).

For radiological safety and effective decontamination of RI protective clothing, washing by fully automatic closed system laundry cleaning machines is adequate. In order to decontaminate RI protective clothing (cotton cloth) by Economat, commercial laundry cleaning machine, various conditional examinations were carried out and the program of washing procedure was obtained. This program can be applied to other types of laundry cleaning machines when suitable modification is done. (NSA of Japan) (auth)

9961 CELL PROLIFERATION AFTER IRRADIATION. Wailly, Louis Frank. Fort Collins, Colo., Colorado State Univ., 1968. 255p.

Thesis.

Two aspects of radiation dosimetry were studied, biological dosimetry, and physical dosimetry. The former was studied in more detail than the latter. The biological dosimetry was concerned with specific patterns of hemopoiesis following an irradiation exposure, especially erythropoiesis. Erythropoiesis essentially ceases as mammals are exposed to radiation doses in the range of three times that of the $LD_{50(30)}$. It was established that the magnitude of the erythrocytic proliferation after irradiation was a function of total dose from a single exposure. Three groups of adult female dogs were used for this experiment. Group I, the control group of five dogs, received no irradiation and each animal was given 13.2 μCi/kg of glycine-2-C-14 intravenously. Group II, containing thirteen animals, received the same amount of C-14 glycine as the control group immediately following irradiation from a ^{60}Co source. Group III, composed of ten dogs, was injected with the labeled glycine on the fourth day following exposure to the ^{60}Co source. Identical exposures were experienced by Groups II and III; (50 R, 100 R, 200 R, 600 R, and 800 R). Exposure rates of 53 R/min were made at a point corresponding to the mid-line of the animal. With damage to the stem cell compartment, the red cell renewal system (if properly tagged at the optimum time) gave a cell population that was an indicator of residual injury. This injury was shown to be dose dependent. Part two of this study illustrated the energy dependence of depth dose patterns to γ- or x-rays; data were in close agreement with studies of similar shielding materials. A detailed study is presented comparing the efficiency of a solid state thermoluminescent dosimetry system to that of a previously proven tissue equivalent ionization chamber. Absorbed dose measurements indicated variances in dose due to changes in animal configurations, especially with exposures made with lower energies. In-vivo measurements related accurate depth dose determinations with the use of LiF in teflon dosimeters. (Diss. Abstr.)

9962 QUANTITATIVE DETERMINATION OF THE ACTIVITY OF IN VIVO GAMMA-RAY EMITTING RADIOISOTOPES BY WHOLE-BODY COUNTING. Genna, Sebastian. Boston, Boston Univ. Graduate School, 1967. 115p.

Thesis.

A generalized approach to the determination of whole-body radioactivity, that accounts for γ-ray attenuation within the human body and the efficiency of the γ-ray detectors relative to the radioactive source distribution, was developed. The method depends on a mathematically derived expression in which the radioactive content of a human body is given as a function of: the subject's body count rate, the count rate from a calibrated source, an energy dependent effective attenuation coefficient, and a set of energy independent parameters that are dependent on body habitus and radioisotope distribution within the body. The method of determining the values of the variables, given in the first three items, for a particular whole-body counting geometry was presented. One of the set of energy independent parameters, the center of activity of the radioisotope distribution in the anterior-posterior direction, was obtained directly from the subject's body counts. The utility of the method rests on the assumption that the remaining parameters could be related to measurable indices of body habitus by means of in vivo calibrations, or could be estimated from measurements with radiation sources external to the body or from approximations of the radioisotope distribution. The method was applied to both static and changing radioisotope distributions and the errors were evaluated. The static distributions consisted of situations in which the radioisotope occupied the extracellular fluid, the intracellular space, or the plasma volume. The calibrations, i.e., determinations of the complete set of parameters applicable to a given radioisotope distribution as a function of an index of body habitus, were applicable to the measurement of body content of radioisotopes having comparable distributions but emitting γ-rays of different energies. Examples of the application of the method of determining the activity when the radioisotope distribution was not static were also given. These consisted of the measurement of the retention of ^{131}I following its administration in ionic form and the determination of the set of parameters applicable to the distribution of ^{131}I-rose bengal in the liver. This application required a knowledge of the kinetic behavior of the radioisotopic tracer, i.e., the fractional content of the radioisotope in the different spaces occupied by it as a function of time, as well as the particular set of parameters applicable to each body space. (Disser. Abstr.)

9963 ^{85}Sr AND ^{134}Cs ACTIVITY IN MILK AFTER A SINGLE CONTAMINATION OF PASTURE. van der Hoek, J.; Kirchmann, R. J. Tijdschr. Diergeneesk., 93: 1121-32(1968).

The development of milk activity of ^{85}Sr and ^{134}Cs after a single contamination of an old permanent pasture and a newly sown in temporary sward in the early and late phases of the grazing season was studied. Both nuclides are rapidly secreted into milk and obtain their highest values in four to seven days after the cows have access to contaminated pasture. The difference in type of pasture had no influence on the maximal activity per liter of milk. However, the decrease in concentration of strontium and cesium in milk appeared to occur more slowly on temporary than on permanent pasture. The transfer coefficients for strontium (the percentage of the deposited activity per m^2 or of the activity of grass per kg dry matter respectively, that is secreted per liter of milk) remained about the same for all four experiments and varied between about 1 to 1.5% and 0.30 to 0.45% respectively. In contrast to this, the transfer coefficients for cesium have values 2 to 3 times higher for the August and September experiments; they vary from about 5 to 17% and from 2 to 4% respectively. The possible reasons for this differential behavior of cesium are discussed but a satisfactory explanation cannot be given. Finally, the health physics aspects of the results of this experiment are reviewed. (auth)

9964 A STUDY ON PERCUTANEOUS ABSORPTION OF RADIOISOTOPES. Takeuchi, Yoshiko (Tokyo Univ.). Hoken Butsuri, 3: 327-38 (Sept. 1968). (In Japanese).

The percutaneous absorption of radioisotopes and the first aid procedure for skin contamination accidents was investigated. In the experiments on percutaneous absorption, a small amount of carrier free ^{32}P (pH 1) or ^{90}Y (pH < 1 = 10) was pipetted on the normal and the injured skin of rats, and the absorption of these radionuclides was measured for about one hr using the outer counting method. Autoradiographs of the skin contaminated with ^{32}P or radiocolloidal ^{198}Au were made. Percentage of absorption of ^{32}P through the normal skin was 6.5% of the applied amount. With injury on the skin, the amounts absorbed ranged from 20 to 90%, depending on depth and bleeding state of the wound, but coagulated blood that covered the wound was as good a barrier against the absorption of the radioisotope as the normal skin. The absorption of ^{90}Y was affected by pH and radiocolloidal ^{90}Y was absorbed with difficulty through the normal and the injured skin. To investigate blocking means against percutaneous absorption, the effects of washing and of administration of tannic acid and epirenamine-hydrochlor were examined. Epirenamine-hydrochlor had, although for short time, a strong blocking effect against absorption into the body. From this result, the use of peripheral-angiotonics was proposed as a first aid procedure for skin contamination accident. (NSA of Japan)

9965 RADIATION EXPOSURE OF URANIUM MINERS. SUMMARY ANALYSIS OF HEARINGS MAY 9, 10, 23, JUNE 6, 7, 8, 9, JULY 26, 27, AND AUGUST 8 AND 10, 1967, BEFORE THE SUBCOMMITTEE ON RESEARCH, DEVELOPMENT, AND RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETIETH CONGRESS, FIRST SESSION, DECEMBER 1967. Washington, D. C., Joint Committee on Atomic Energy, 1967. 60p. GPO.

Epidemiological data on several thousand uranium miners was collected during the past fifteen years by the Public Health Service. Analysis of the data led to the establishment of a 0.3 Working Level standard, the scientific basis of which was examined by the Joint Committee. The Committee examined whether the Department of Labor standard as written could be legally enforced inasmuch as it did not appear feasible to sustain a meaningful safety program at the 0.3 Working Level with the existing technology. The hearings disclosed certain discrepancies and misunderstandings associated with the Public Health Service epidemiological study. The Secretary of Health, Education, and Welfare subsequently requested a review of the study, from which it was concluded that the PHS projections of mortality from past and future experience in the mines could not be substantiated. Information generated during the hearing shed new light on several important facets of the miner exposure problem. Although there is still no positive evidence of the cumulative effects of exposure at levels of radiation as low as that embodied in the new standard, it is clear that deaths owing to lung cancer among uranium miners were associated with exposure to excessively high levels of radon daughters that existed in the 1940's and 1950's, but that are no longer characteristic of the underground uranium mining operations. Thorough epidemiological studies were judged to be the best available scientific basis for establishing the relationship between exposure to short-lived radon daughters and the subsequent development of lung cancer. An accelerated Research and Development program is being implemented in accordance with an interagency plan formulated by the AEC and the Departments of HEW, Labor, and Interior. Testimony relating to pathological studies on human radium exposure cases suggest the possible existence of a practical threshold level of exposure, below which the risk of inducing lung cancer would be negligible during the normal life span of the individuals exposed. (H.L.W.)

9966 IMPROVEMENTS IN OR RELATING TO PROTECTIVE SUITS. Fountain, Alec William (to United Kingdom Atomic Energy Authority). British Patent 1,111,227. Apr. 24, 1968. Filed Oct. 21, 1965.

A description is given of a protective suit that completely encloses the wearer and seals him off from a toxic environment such as air containing radioactive dust or dangerous liquids that may splash. The suit has arm, body, head, and leg portions made of impermeable flexible material and has a transparent area at the front of the head portion. There is a sealable entry for the wearer comprising a reinforced waist portion, an inlet supported by the waist portion for admitting air from a hose to the suit, a flexible conduit inside the suit for leading air from the inlet to the top of the head portion. There is an inlet toward the front of the head portion to allow air to enter the suit and an outlet supported by the waist portion for allowing air to pass out of the suit. The outlet is adapted to provide a pressure drop whereby the air pressure in the suit can be maintained above that of the external atmosphere. There are flexible conduits inside the suit for leading air from the extremities of the arm and leg portions to the outlet. (H.L.W.)

9967 PROBLEMS OF ACCIDENTAL RADIATION. Kozinets, G.; Antoni, F. (IAEA, Vienna). Israel J. Med. Sci., 4: 495-8 (May-June 1968).

A radiation accident is defined as any unforeseen and unjustified irradiation of individuals. It is pointed out that exposure to even small doses of radiation should be avoided, since the threshold doses that lead to the development of leukemia or cancer are unknown. The biological effects of various doses of γ and x radiation on man are reviewed. It is pointed out that most of the radiation accidents in industry occur as a result of some kind of technical malfunction. Radiation accidents in medicine were avoided in recent years in the U.S.S.R. by the training of personnel, and maintaining state control over all sources of ionizing radiation. (C.H.)

9968 EFFECT OF DELTA-RAY BUILDUP IN HIGH-ENERGY DOSE CALCULATIONS. Vora, R. B.; Prasad, M. A.; Turner, J. E. (Bhabha Atomic Research Center, Bombay). Health Phys., 15: 139-43 (Aug. 1968).

Dose buildup due to delta rays in a soft-tissue slab bombarded by normally incident protons was studied with a view towards assessing its possible effect in high-energy dose calculations. Relative contributions of delta rays with energies above 0.65, 1.13, and 2.17 MeV (ranges 0.25 cm, 0.5 cm, and 1 cm, respectively) to the total stopping power for protons in the energy range 400 MeV to 2 GeV are given. Delta-ray energy and angular distributions were computed for 2-GeV protons. Based on these computations and on experimental electron energy dissipation data for water, it is estimated that the buildup in dose due to delta rays is ~8–9% and that it occurs in the first 2–3 cm of depth within the slab. (auth)

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Refer also to abstracts 9388, 9430, 9754, 9810, 9834, 9842, 9851, 9869, 9932, 9933, 9935, 9959, 10071, 10074, 10104, 10883, and 10893.

9969 (AEC-tr-6713) PATHOGENESIS, CLINICAL TREATMENT AND THERAPY OF ACUTE RADIATION SICKNESS BASED ON EXPERIMENTS WITH MONKEYS (AN ALL-UNION SYMPOSIUM). Lapin, B. A. (ed.). Translation of Patogenez, Klinika i Lechenie Ostroi Luchevoi Bolezni v Opytakh na Obez'yanakh (Materialy Vsesoyuznogo Simpoziuma) Izdatel'stvo, Alashara, Sukhumi USSR, 1964. 44p. (IPST-Cat.-1810). CFSTI.

Separate abstracts were prepared for seven chapters. The similarity of monkeys to humans makes them more desirable than other commonly used experimental animals for studies on radiation sickness. (H.L.W.)

For abstracts of individual chapters see: 9970–9976.

9970 (AEC-tr-6713, pp 1-10) CHARACTERISTICS OF RADIATION SICKNESS IN MONKEYS AND THE ROLE OF INFECTION IN ITS DEVELOPMENT. Yakovleva, L. A. Translated from Patogenez, Klinika i Lechenie Ostroi Luchevoi Bolezni v Opytakh na Obez'yanakh (Materialy Vsesoyuznogo Simpoziuma) Izdatel'stvo, Alashara, Sukhumi USSR, 1964.

A review of the literature on the pathology of monkeys killed by γ or x radiation is presented. Changes in hemopoietic organs occurred earlier and were more distinct in the lymphatics than in bone marrow. A progressive decrease in the number of lymphocytes in the spleen and lymph nodes occurred. Decrease in the total number of cells in the bone marrow was associated with a massive transfer of mature leukocytes into the peripheral blood a few hours after irradiation. In some cases a severe radiation sickness led to the development of aplastic anemia associated with transition of the bone marrow into fibroreticular tissue. A relatively insignificant disturbance of physiological regeneration of the intestinal epithelium was observed. Effects of radiation sickness on the gonads were considerably more pronounced in males than in females. The number of spermatogonia was considerably decreased within the first week after irradiation. Changes in the ovaries consisted of a diffuse disintegration of the germinal epithelial cells of the immature follicles. The decrease in resistance to infection was explained by damage to various factors involved in natural defense mechanisms and in disturbances of mechanisms associated with induced immunity. The most frequent complication of acute radiation sickness was colitis caused by dysentery bacilli. Other complications were pneumonia and infections of the oral cavity and pharynx. (H.L.W.)

9971 (AEC-tr-6713, pp 11-18) PREVENTION OF ACUTE RADIATION SICKNESS IN MONKEYS. Semenov, L. F. Translated from Patogenez, Klinika i Lechenie Ostroi Luchevoi Bolezni

v Opytakh na Obez'yanakh (Materialy Vsesoyuznogo Simpoziuma) Izdatel'stvo, Alashara, Sukhumi USSR, 1964.

Radiation sickness was induced in rhesus monkeys by γ radiation from a ^{60}Co source and by x radiation. Protective effects of various compounds were studied. β-mercaptoethylamine and cystamine injections protected monkeys exposed to 650 to 700 R of ionizing radiation. Combined treatment with adrenaline and acetylcholine gave protection against radiation sickness of various degrees of severity. Indole amine derivatives, such as serotonin, mexamine, and tryptamine, given together with acetylcholine, protected 30 to 40% of animals exposed to MLD of ionizing radiation. (H.L.W.)

9972 (AEC-tr-6713, pp 19-21) VACCINATION AND ANTIBIOTIC TREATMENT OF ACUTE RADIATION SICKNESS IN MONKEYS. Klemparskaya, N. N.; Raeva, N. V.; Usacheva, I. N. Translated from Patogenez, Klinika i Lechenie Ostroi Luchevoi Bolezni v Opytakh na Obez'yanakh (Materialy Vsesoyuznogo Simpoziuma) Izdatel'stvo, Alashara, Sukhumi USSR, 1964.

Vaccines used were living Escherichia coli M17 and BCG vaccine. They were injected intracutaneously into 12 monkeys, and 18 monkeys that were not vaccinated served as controls. One month later monkeys were exposed to total body γ irradiation. One day after irradiation and on the following 30 days monkeys received oxytetracycline, phenoxymethylpenicillin, streptomycin, vitamins B_1, B_2, and C. A group of five monkeys was not vaccinated but was treated with antibiotics and vitamins. Results are tabulated. The mildest course of radiation sickness was observed in monkeys vaccinated prior to irradiation and treated with antibiotics and vitamins after irradiation. The only symptom was an altered blood picture that returned to normal sooner than in surviving control animals. Monkeys that received antibiotics only were much less radioresistant than monkeys that were both vaccinated and treated with antibiotics. (H.L.W.)

9973 (AEC-tr-6713, pp 22-6) TREATMENT OF RADIATION SICKNESS IN MONKEYS BY AUTOTRANSPLANTATION OF BONE MARROW FROM SCREENED PARTS. Barkaya, V. S.; Lapin, B. A.; Semenov, L. F.; Strelin, G. S.; Shmidt, N. K. Translated from Patogenez, Klinika i Lechenie Ostroi Luchevoi Bolezni v Opytakh na Obez'yanakh (Materialy Vsesoyuznogo Simpoziuma) Izdatel'stvo, Alashara, Sukhumi USSR, 1964.

While monkeys were exposed to γ and x radiation, thighs and shins were shielded with lead. Bone marrow was extracted from shielded parts following irradiation and suspensions were injected intravenously into the monkeys. Criteria used for assessing the course of radiation sickness and the effect of autotransplantation were survival time, general physical condition, blood picture, and pathological features of animals that died from irradiation. All monkeys exhibited typical symptoms of acute radiation sickness, although secondary reactions, seen in animals after homologous transplantation and caused by immunological incompatibility, were never observed. Hematological studies showed that autotransplantation of bone marrow did not prevent suppression of hematopoiesis, but accelerated regeneration of hematological tissue. (H.L.W.)

9974 (AEC-tr-6713, pp 27-31) COMPOSITE TREATMENT OF RADIATION SICKNESS IN MONKEYS. Rogozkin, V. D.; Trushina, M. N. Translated from Patogenez, Klinika i Lechenie Ostroi Luchevoi Bolezni v Opytakh na Obez'yanakh (Materialy Vsesoyuznogo Simpoziuma) Izdatel'stvo, Alashara, Sukhumi USSR, 1964.

Twenty-two monkeys were exposed to γ radiation and 14 served as controls. Effects of treatment were judged by survival of animals for 45 days following irradiation, clinical course of radiation sickness, blood picture, bacteriological and postmortem examinations. Composite therapy with terramycin, streptomycin, vitamins B_1, C, and P, and hemopoietin increased survival time of irradiated monkeys. Addition of prednisolone and vitamins B_2 and B_6 enhanced the therapeutic effect of terramycin and streptomycin led to a milder course of radiation sickness and prolonged survival time. Orotic acid abolished the therapeutic effect of the above drugs. (H.L.W.)

9975 (AEC-tr-6713, pp 32-5) TREATMENT OF INFECTIOUS COMPLICATIONS OF RADIATION SICKNESS IN MONKEYS. Tumanyan, M. A. Translated from Patogenez, Klinika i Lechenie Ostroi Luchevoi Bolezni v Opytakh na Obez'yanakh (Materialy Vsesoyuznogo Simpoziuma) Izdatel'stvo, Alashara, Sukhumi USSR, 1964.

Monkeys developed radiation sickness following exposure to x or γ rays. Treatment with antibiotics alleviated the symptoms considerably; treated monkeys did not develop infections. In some experiments all monkeys treated with antibiotics and exposed to lethal doses of radiation, survived. Antibiotics used were albomycin, colimycin, chloramphenicol, penicillin, phthalazole, and streptomycin. After cessation of treatment with antibiotics, some animals developed an exogenous infection and died after all symptoms of radiation sickness disappeared. (H.L.W.)

9976 (AEC-tr-6713, pp 36-42) INFECTIONS AND IMMUNITY IN LONG-TERM, CONTINUOUSLY IRRADIATED MONKEYS. Dzhikidze, E. K. Translated from Patogenez, Klinika i Lechenie Ostroi Luchevoi Bolezni v Opytakh na Obez'yanakh (Materialy Vsesoyuznogo Simpoziuma) Izdatel'stvo, Alashara, Sukhumi USSR, 1964.

Monkeys developed radiation sickness following exposure to long-term, continuous exposure to ionizing radiation. The rate of development and the nature of the sickness depended primarily on the radiation dose and on the amount of accumulated radioactivity. Exposure to 16 to 25 R daily with accumulated 450 to 750 R led to development of severe radiation sickness, while exposure to 1 R daily with accumulation of 500 to 800 R led to development of few symptoms. Systematic exposure to ionizing radiation led to a lowered natural immunity, heightened susceptibility to infections, and activation of latent infections. Prolonged irradiation caused changes in specific immunological reactivity, that became manifest in gradual suppression of antibody formation. (auth) (TSS)

9977 (CEA-R-3610) STUDY OF THE IMPROVEMENT OF THE RADIOPROTECTIVE POWER OF IMIDAZOLE. Mourret, Andree; Rinaldi, Renaud (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sept. 1968. 12p. (In French). Dep.

Depamide was found to reduce the toxic effects of the radioprotective compound imidazole in mice. The combined use of the two drugs increased the survival of mice following exposure to doses of x radiation ranging from 750 to 900 R. (C.H.)

9978 (CNEA-213) PREPARATION AND BIOLOGICAL BEHAVIOR OF A RADIOACTIVE GOLD COLLOID PROTECTED BY PVP. Caro, R. A.; de Paoli, T.; Hager, A.; Nicolini, J.; Radicella, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1968. 24p. (In Spanish). Dep.

The preparation of ^{198}Au colloids of different particle size, stabilized by polyvinylpyrrolidone (PVP), is described. After the injection of the colloids into the dorsal vein of the tail and the rear paw of mice, its distribution was determined. Tissue distribution is compared to the distribution of similar colloids stabilized by gelatin. (C.H.)

9979 (COO-1422-23) A COMPARISON OF RADIOLOGICAL METHODS FOR DETERMINING BONE MINERAL CONTENT. Mazess, Richard B.; Cameron, John R.; Sorenson, James A. (Wisconsin Univ., Madison). Feb. 15, 1968. Contract AT-(11-1)-1422. 25p. (CONF-680211-2). Dep. CFSTI.

From Conference on Progress in Methods of Bone Mineral Measurement, Bethesda, Md.

The three principal methods used for quantitative radiological evaluation of the extent of skeletal mineralization were compared. These included: morphometric method, in which the thickness of the total bone or of its cortical walls is measured on the image of a long bone shaft seen on a standard radiograph, and these thicknesses are presumed to reflect bone mass at the measurement site; photodensitometric method, in which photodensitometer trace is made across the bone image on a standard radiograph, and optical density, indicating the apparent transmittance through the bone, is referenced against the transmittance of a calibration wedge exposed adjacent to the bone in order to get values approximately proportional to bone mineral mass; and photon absorptiometry in which a narrow monoenergetic photon beam from a low energy radionuclide source is passed across the bone, and the changes of transmittance, which are directly proportional to the mineral mass in the scan path, are measured with a scintillation detector-pulse height analyzer system. It was concluded that cortical measurements from radiographs are moderately correlated with bone mineral content at certain skeletal locations. Photodensitometric traces are no more highly associated with bone mineral mass of tissue-covered bones than the simpler cortical variables. Further, both morphometric and photodensitometric observations on radiographs appear to have about equal precision (5 to 10%). Both methods, if validated, could be used for assessment of skeletal mineralization on grouped data, but both are inadequate for prediction of bone mineral mass with an accuracy sufficient for individual observations. In adult populations the normal variability in mineral content is only about 20 per cent and hence is equal to or less than the errors of radiographic methods of mineral determination. In contrast, the direct absorptiometric method is highly precise, accurate, and reliable, but at present is limited to application on the appendicular skeleton. (C.H.)

9980 (JPRS-44356) MEDICAL RADIOLOGY. Translated from Med. Radiol., 12: No. 11, 3-52; 65-79(1967). 86p. CFSTI.

Six articles discuss the development of medical radiology in the U.S.S.R. Separate abstracts were prepared on four of these articles. (C.H.)

For abstracts of individual papers see: 9931, 9932, 9981, and 9982.

9981 (JPRS-44356, pp 30-40) CLINICAL RADIOISOTOPIC DIAGNOSTICS IN THE USSR. Agranat, V. Z.; Zubovskiy, G. A.; Lyass, F. M. Translated from Med. Radiol., 12: No. 11, 26-34(1967).

Developments in the use of radioisotopes for clinical diagnosis during the last 25 years in the U.S.S.R. are reviewed. Applications in the localization of neoplasms and in physiological studies, the development of labeled pharmacological compounds, and the reduction of the radiation dose to patients during radioisotope scanning are discussed. (C.H.)

9982 (JPRS-44356, pp 41-64) SPECIAL RESULTS AND PROSPECTS OF DEVELOPMENT OF RADIATION THERAPY IN THE USSR. Kozlova, A. V.; Lindenbraten, L. D. Translated from Med. Radiol., 12: No. 11, 35-52(1967).

Developments in radiation therapy in the U.S.S.R. from 1896 to the present are reviewed. Progress in biological research, physics, engineering, and dosimetry related to radiation therapy during the past 20 yrs is discussed. (64 references.)

9983 (RLO-353-31) FACTORS WHICH GOVERN PLANT RADIOSENSITIVITY. Three-Year Summary Report, 1965-1968. Nilan, R. A.; Konzak, C. F. (Washington State Univ., Pullman. Dept. of Agronomy). Nov. 1968. Contract AT(45-1)-353. 13p. Dep. CFSTI.

Progress is reported on studies of mechanisms by which radiation injuries are induced, prevented, and repaired in plant cells. Results are reported from studies on the effects of oxygen on the x-radiosensitivity of dry barley seeds. It was concluded that possible mechanisms by which oxygen pressure may induce biological damage in seeds include the accelerated rate of normal oxidative processes, the formation of peroxides, and the formation of long-lived free radicals. (C.H.)

9984 (UCLA-12-686, pp 21-31) BIOPHYSICS. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Developments in instrumentation and methodology of the various procedures used for studies of cultured cells are reported. An electrophoretic cell separator was improved and methods for the determination of the density and volume distributions of blood cells by centrifugation in linear gradients of bovine serum albumin were improved. An improved under-the-table, high-speed section scanner was tested for the localization of tumors. A spherical cap nest of seven 3-in. crystals allows visualization of the shape and spatial extent of brain tumors following the injection of ^{99}Tc. Computer programs were written in PL/I for use on the IBM 360 computer for the solution of neutron activation and decay problems. Methods for the study of the effects of ^{60}Co γ radiation at the macromolecular level in living cells were tested in Neurospora crassa using the rate of synthesis of tyrosinase as the test system. (C.H.)

9985 (UCLA-12-686, pp 32-52) NUCLEAR MEDICINE. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Progress is reported on the development of radioisotope scanning procedures for use in the diagnosis of neoplasms or in physiological studies in patients. Sequential scanning with ^{131}I-rose bengal was of value for the diagnosis of hepatic bile duct obstruction and cirrhosis. The limitations of quantitative lung scanning using ^{131}I-albumin macroaggregates for measurements of regional blood flow were investigated in dogs. Comparative semiquantitative studies using ^{133}Xe gas indicated that peripheral deposition of inhaled aerosols in the respiratory tract is proportional to ventilation, and it was concluded that ventilation studies with ^{133}Xe can be used clinically to differentiate ischemia from primary vascular occlusion from most other causes of regional ischemia. Studies on the uptake of ^{99}Tc-pertechnetate and ^{197}Hg by human brain tumor cells in vitro indicated a possible cell-type specificity for these radioisotopes. The use of a scintillation camera with ^{133}Xe, ^{99}Tc-albumin microaggregates, or ^{99}Tc-pertechnetate for studies of blood circulation in the brain is discussed. Evaluation of several radioactive aerosols for use for scanning lungs for detection of regional disturbances of pulmonary function showed that ^{99}Tc-Fe-EDTA chelate was the most suitable agent of those tested. Serial scans made at 10 to 30 min intervals in normal subjects demonstrated that this agent was absorbed and removed from the lungs at approximately equal rates from all regions of the lung. Pharmaceutical preparations of short-lived radionuclides were evaluated as kidney scanning agents. These included ^{99}Tc-Fe-EDTA, ^{99}Tc-Fe-DTPA, ^{113}In-EDTA, ^{99}Tc-Fe-glucose, and ^{99}Tc-Fe-citrate complexes. All of the agents except the citrate complex were effective for kidney scanning and function tests. It was concluded they can be substituted for radiomercurial kidney scanning agents to improve counting statistics and reduce the radiation dose to patients. Whole-body counting was used to study the metabolic kinetics of gamma globulins in humans following the intravenous injection of gamma globulins labeled with ^{125}I or ^{131}I; for measurements of the absorption of ^{59}Fe and ^{47}Ca in patients with a variety of disorders; and for measurements of the content of ^{235}U in individuals exposed during industrial work. (C.H.)

9986 (UR-49-987) DYNAMICS OF DUST REMOVAL FROM THE LOWER AIRWAYS: MEASUREMENTS AND INTERPRETATIONS BASED UPON RADIOACTIVE AEROSOLS. Morrow, Paul E. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). Aug. 14, 1968. Contract W-7401-eng-49. 29p. (CONF-680814-1). Dep. CFSTI.

From Symposium on Airway Dynamics, Haverford, Penna.

Experimental studies on dust deposition in the respiratory tract are reviewed. It is pointed out that most laboratory studies use monodisperse particles, but such aerosols are rarely found in nature. Problems related to the anatomy and physiology of the respiratory tract, the physical properties and intrinsic instability of aerosols, the relation between particle size and deposition probability, the relation between particle number and mass in heterodisperse aerosols, and the development of suitable models of deposition for dust clouds and therapeutic aerosols are discussed. Two techniques using heterodisperse and monodisperse radioactive aerosols are described. It is concluded that, while both methods usually provide some information on particle clearance in different zones of the respiratory tract, there has been little success in utilizing the clearance of a radioactive aerosol as a bronchial or pulmonary function test. (C.H.)

9987 CONCENTRATED RADIOTHERAPY: IMMEDIATE RESULTS IN THE FIRST 200 CASES. Gest, J.; Delouche, G. (Centre Rene-Huguenin de Lutte Contre le Cancer, Saint-Cloud, France). Sem. Hop. Paris, 43: 2657-62(Oct. 20, 1967). (In French).

Radiobiological bases for intensive irradiation of certain tumors were considered and a survey was made of 200 cases treated by concentrated radiotherapy during the last two years. The factor of time was stressed in the modification of tissue response. A dose of 2000 R in 24 hr was given to the tumor by means of ^{60}Co, followed by one or two doses of 1000 R, four and eight weeks after the first dose. In some cases the standard series of smaller doses was used a month after the concentrated dose. Postoperative radiotherapy and combined therapy with x rays and Ra were also sometimes used. In the 200 cases reviewed, treatment was tolerated without injury. Palliative radiotherapy was made possible for certain patients in poor condition with the concentrated method, whereas a protracted irradiation could have been unfavorable. Three groups of patients were chosen at random for further study. It was predicted that two more years were required to evaluate the value of this new method. (BBB)

9988 LUNG SCANNING WITH ^{87m}Sr IN METASTATIC OSTEOSARCOMA. Samuels, L. D. (Ohio State Univ., Columbus). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 104: 766-9(Dec. 1968).

Lung scannings with strontium-87m have been performed in 5 patients with osteosarcoma with pulmonary metastases. Localization of this boneseeking isotope in soft tissue metastases is reported and the future use of this radioisotope for diagnosis is suggested. (auth)

9989 DIAGNOSIS OF INTRACRANIAL TUMOURS ASSISTED BY COMPUTER. du Boulay, G.; Price, V. E. (St. Bartholomew's Hospital, London. City Univ., London). Brit. J. Radiol., 41: 762-81(Oct. 1968).

A computer program is described whereby the diagnosis of an intracranial tumor may be made from the probabilistic basis by comparison with previous patients. The data employed are signs elicited by radiological examination. A second program predicts the next most informative test not yet performed, e.g., vertebral angiography. Some early results are encouraging. (auth)

9990 STATIONARY FIELD TREATMENT PLANNING AT FIXED SOURCE-TUMOR DISTANCE. Buchan, R. C. T. (Plymouth General Hospital, Eng.). Brit. J. Radiol., 41: 692-5 (Sept. 1968).

Although there are important advantages in using a fixed source-tumor distance (STD) in rotating supervoltage beam therapy, preparation of treatment plans is complicated by the varying source-skin distance (SSD). A new method of preparing dose distributions and treatment times for fixed STD was described, which used fixed

SSD isodose charts, with appropriate corrections. Sources of error were discussed, and a typical treatment plan presented. (auth)

9991 THE INFLUENCE OF GYNECOLOGICAL RADIUM IRRADIATION ON THE DISINTEGRATION TENDENCY OF THROMBOCYTES. Bach, W.; Wille, P. (Univ., Berlin). Zentralbl. Gynaekol., 87: 625-30(May 8, 1965). (In German).

In 25 patients irradiated with an average of 2000 mg-hr of Ra the thrombocyte-fragility index was measured. Platelet lability peaked immediately after irradiation, then decreased until day five, and finally increased to a maximum by day seven. The thrombocyte count decreased until day seven, and paralleled the amount of irradiation given. Platelet numbers increased as the lability increased. The biphasic changes in the thrombocyte count and platelet lability after irradiation were similar to what have been observed after surgery. The initial change in platelet lability probably was due to irradiation trauma, and the second peak probably resulted from a regulatory reaction of the body to the opposing recovery of the thrombocytes. The platelets released from the bone marrow after the thrombocyte crisis appeared to have greater lability and disappeared relatively shortly after they appeared in the peripheral blood. The tendency of the blood platelets to disintegrate after gynecologic Ra therapy explains the tendency toward thromboembolic complications observed in connection with Ra irradiation. It shows that thromboembolic prophylaxis is indicated in Ra-treated patients. (BBB)

9992 LABELLING OF RED BLOOD CELLS WITH ^{81}Rb FOR SPLEEN SCANS. Friedmann, B.; Lewis, S. M.; Glass, H. I.; Szur, L.; Watson, I. A. (Royal Postgraduate Medical School, London. Hammersmith Hospital, London). Brit. J. Radiol., 41: 815-18(Nov. 1968).

For spleen scanning there may be advantages in damaging red cells with non-radioactive 1-mercuri-2-hydroxypropane (MHP) and labelling them with a short-lived isotope which emits medimum energy γ rays. This is especially so if quantitative measurement of red-cell destruction in the spleen is to be attempted. ^{81}Rb has been proposed as an isotope of choice for this purpose. Factors which influence the uptake of rubidium by red cells have been studied; it has been found that it is mainly dependent on the concentration of ionic Rb^+ and only to a minor extent on the volume of red cells in the incubation mixture. ^{81}Rb, together with non-radioactive Rb^+ in a concentration of about 5 mMl^{-1} gives maximum labelling efficiency. A technique has been developed which ensures that blood can be labelled with ^{81}Rb with an efficiency of 15 percent per ml. of red cells. This is sufficient to produce a satisfactory spleen scan, and results in a radiation dose to the spleen of 16.5 mrads per μCi injected. This is considerably less than would result from a scan with a comparable injected activity of ^{51}Cr-labelled cells, and the scan quality is much superior with ^{81}Rb. (auth)

9993 QUANTITATIVE ESTIMATION OF RED-CELL UPTAKE IN THE SPLEEN USING ^{81}Rb- AND ^{51}Cr-LABELLED RED CELLS. Szur, L.; Glass, H. I.; Lewis, S. M.; Grammaticos, P.; de Garreta, A. C. (Royal Postgraduate Medical School, London. Hammersmith Hospital, London). Brit. J. Radiol., 41: 819-25(Nov. 1968).

A method is described for converting the data obtained by external counting after administration of ^{51}Cr-labeled red cells into a quantitative measurement of splenic sequestration. This involves the administration at a later stage of a second sample of red cells, which are double labeled with ^{81}Rb and ^{51}Cr and are damaged in vitro with 1-mercuri-2-hydroxypropane to ensure their preferential uptake by the spleen. By means of a scan of the ^{81}Rb activity the fractional uptake of the in vitro-damaged cells by the spleen can be measured, and then related to the external count. This permits the sequestration by the spleen of ^{51}Cr-labeled natural cells to be estimated quantitatively. This provides a more reliable measurement than external counting alone in evaluating the role of the spleen in hemolytic anemias and the indications for splenectomy. The reasons for selecting ^{81}Rb and the theoretical considerations are presented. The method has been applied in a study on a patient suffering from hereditary spherocytosis. There was an uptake of 14.3 percent of ^{51}Cr-labelled red cells in the spleen in a 15-day period. This represented approximately 28 percent of the ^{51}Cr-labeled cells. (auth)

9994 RENAL CONCENTRATION OF ^{131}I-ROSE BENGAL CONFUSING THE INTERPRETATION OF ABDOMINAL SCANS IN LIVER DISEASE. Freeman, Leonard M.; Kay, Chester J.; Derman, Arnold (Albert Einstein Coll. of Medicine, Bronx, N. Y. Bronx Municipal Hospital Center, N. Y.). Brit. J. Radiol., 41: 826-8(Nov. 1968).

The renal excretion of radioiodinated Rose Bengal is significantly increased in patients with severe intrahepatic disease as well as those with obstruction of their extrahepatic biliary tracts. Based upon experimental evidence, it is suggested that free ^{131}I dissociated from Rose Bengal, in vivo, accounts for most of this urinary activity. Renal excretion of radioiodinated Rose Bengal on a scan must be distinguished from intestinal activity to avoid a mistaken impression of biliary tract patency in cases where the obstruction actually exists. Serial and lateral scans are very helpful in this regard. (auth)

9995 ISOTOPE NEPHROGRAM IN ESSENTIAL HYPERTENSION. Andreew, I. (Institut fuer Kortiko-Viszerale Pathologie und Therapie, Berlin). Deut. Gesundheitsw., 23: 1686-90(Sept. 5, 1968). (In German).

The characteristics of some parameters of the isotopic nephrogram in the various degrees of clinical severity of 292 hypertonics are reported. Essential hypertonia produced changes in the isotopic nephrogram which depend on the severity of the disease. In the advanced stage, especially in cases of renal complications, these changes are significant. A decline of the amplitude of the isotopic nephrogram, a decline of the angle of inclination of the IInd segment, as well as a low-grade tendency towards a prolongation of the transit period were observed. Particular importance was attached to the decline of the angle of inclination of the IInd segment and it was concluded that the isotopic nephrogram has to be duly considered within the diagnostics of essential hypertonia. (tr-auth) (CO)

9996 EFFECT OF TESTOSTERONE TREATMENT AND HYPOPHYSECTOMY ON THE LEUCOCYTE COUNT IN IRRADIATED RATS. Robinson, E.; Chowers, I. (Hadassah Univ. Hospital, Jerusalem. Hebrew Univ. Medical School, Jerusalem). Acta Radiol., Ther., Phys., Biol., 7: 346-52(Oct. 1968).

Normal and hypophysectomized rats were treated by total and partial body x irradiation and testosterone propionate. It appeared that some impairment occurred in the restoration of the leukocyte count following irradiation in hypophysectomized rats and that testosterone was able to correct this disturbance. (auth)

9997 X-RAY SPECTRA FROM DENTAL X-RAY GENERATORS. PART III. SECONDARY RADIATION. Garcia, Daniel A.; Barr, John H.; Hochberg, David M. (Tufts Univ., Boston). Oral Surg., Oral Med., Oral Pathol., 27: 35-58(Jan. 1969).

A method of calculating the quality of radiation scattered by a patient's head during dental radiography to points normally occupied by the operator is reported. Procedures include construction of an approximate x-ray spectrum and the derivation from this of a first half-value layer and effective energy. An approximate patient-scattered spectrum requires a knowledge of the primary spectrum, calculation from this of a once-scattered spectrum, and modification of the latter spectrum for tissue-absorption effects. Derivations of primary spectra from KVP and filtration were reported in a previous article. Application of Compton and Klein-Nishina equations in constructing once-scattered spectra is described in an appendix to the present article. Experiments were performed to evaluate tissue-absorption effects under conditions representative of dental radiography. Tissue absorption was found to vary with scattering angle but to be negligibly dependent on primary beam quality, within the dental range of interest. A simple function of absorption versus scattering angle was defined. The entire procedure was tested by comparing calculated and measured radiation spectra of scatter from a tissue-equivalent head and neck phantom. Procedures for calculating a first half-value layer of an x-ray beam from its spectrum were outlined and tested. Calculated half-value layers and effective energies for fifteen phantom-scattered radiations are reported. (auth)

9998 NUCLEAR MEDICINE. At. Energy Aust., 11: No. 3, 14-16(July 1968).

Developments in nuclear medicine in Australia are reviewed. The uses of radioisotopes as tracers for metabolic studies and for scanning in the diagnosis and localization of neoplasms are discussed. (C.H.)

9999 MALIGNANT HISTIOCYTOSIS: REPORT OF A CASE AND RESPONSE TO RADIATION THERAPY. Kagan, A. R.; Carpenter, D. F.; Levis, W. R.; Grimley, P. M.; Glover, M. K. (National Cancer Inst., Bethesda, Md.). Radiol. Clin. Biol., 37: 169-81(1968).

The clinical features and response to therapeutic doses of x radiation of a case of malignant histiocytosis are described. (C.H.)

10000 ROLE OF RADIOTHERAPY IN THE TREATMENT OF KELOID. Pant, G. C.; Lall, B. N. Indian J. Radiol., 20: 157-61(1966).

The incidence of keloid is the highest in the second and the third decades of life, more common in the female. The main precipitating factor found was trauma and common site was presternal region. Fractionated-dose therapy of 500 R at

monthly interval for four months, has given best results even in older keloids having moderate vascularity. Single dose therapy has no place even for symptomatic relief. The treatment of choice in old keloids having diminished vascularity is combined treatment by surgery followed by radiotherapy whenever possible. This combined treatment by surgery and radiotherapy has given best results by post-operative fractionated dose therapy of 500 R at monthly intervals for four months. Single preoperative and post-operative exposure is not enough to check the recurrence of keloid. Prophylactic treatment of scars showing keloidal tendency after surgery shows good response to a dose of 200 R daily for six days. (Indian Sci. Abstr.)

10001 SPLIT-SECOND RADIOGRAPHY HALVES EXPOSURE. J. Amer. Med. Ass., 206: 2838(Dec. 23-30, 1968).

An electronic radiography technique that can reduce radiation exposure at least 50% over fluoroscopy is reported. A series of split-second exposures are made, stored on a magnetic disc recorder, and projected by television monitor. The advantages and applications of this method are given. (CO)

10002 SOME PROBLEMS OF THE USE OF RADIOACTIVE SCANNING OF THE LIVER AND SPLEEN IN HEMATOLOGY. Soboleva, S. S.; Zubovskii, G. A.; Milovanova, L. S. (Inst. of Medical Radiology, Minsk). Probl. Gematol. Pereliv. Krovi, 13: 24-30(Dec. 1968). (In Russian).

The significance of radioactive scanning of the liver and the spleen in differential diagnosis between the systemic hyperplastic diseases of the blood and spleno-hepatomegalic syndromes not related to pathology of hemopoiesis are analyzed. (auth)

10003 ELECTRON BEAM THERAPY WITH LINEAR ACCELERATOR PHYSICAL CONSIDERATIONS FOR TOTAL SKIN IRRADIATION THERAPY. Egawa, Jun; Umegaki, Yoichiro (National Cancer Center Hospital, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1475-9(Feb. 1968).

A physical design for total skin irradiation therapy with a linear accelerator was presented. Homogeneity of the dose distribution over the total skin area was achieved by four directional irradiations. Reduction of the electron energy was obtained by using acrylate absorber attached at the end-window of the linear accelerator, but about 5 percent x-ray contamination resulted, which is not a negligible amount for total body injury. By the beam bending method, the electron energy could be reduced to 4 MeV from 6 MeV. (NSA of Japan)

10004 IMPORTANCE OF SCINTIGRAPHY FOR THE DIAGNOSIS OF LOCALIZED BRAIN TUMORS AND LESIONS OF THE OPTIC TRACT. Reisner, H.; Zita, Gerlinde. Wien. Klin. Wochenschr., 80: 788-96(Oct. 25, 1968). (In German).

The results obtained in 16 cases in the use of ^{203}Hg for the scintigraphy of brain tumors that could not be located by normal procedures and of lesions of the optic tract were reported. The results showed that scintigraphy is a significant advance in diagnostic methods of cerebral diseases. It did not give any radiation burden to the patient and had no deleterious effects. (J.S.R.)

10005 IMPROVED PORTABLE TABLE FOR LYMPHOGRAPHY. Kornelsen, R. O.; Stoddart, T. Glen (Ottawa Civic Hospital). Brit. J. Radiol., 41: 706-8(Sept. 1968).

A portable table consisting of an x-ray table-top, an electrical infusion pump to operate syringes, a light-weight air mattress, and storage batteries was designed. It was used for diagnostic lymphograms, intralymphatic injection of colloidal ^{198}Au into dogs and therapeutic doses of ^{131}I and ^{198}Au into patients. (F.M.M.)

10006 CHROMOSOME ABERRATIONS AND NEUTROPHIL ALKALINE PHOSPHATASE IN FORTY-THREE CASES OF LEUKEMIA, INCLUDING FOURTEEN CASES OF LEUKEMIA IN ATOMIC BOMB SURVIVORS. Kamada, N.; Okada, K.; Ito, T.; Nakatsui, T.; Tomonaga, M. (Hiroshima Univ.). Kyushu Ketsueki Kenkyu Dokokaishi, 17: 115-42(1967).

Leukemia in atomic bomb survivors and other patients was studied by means of chromosome analyses and neutrophil alkaline phosphatase (NAP) activity. Of the 43 patients observed, 15 were cases of chronic granulocytic leukemia (CGL) and 28 of acute leukemia. In the bone marrow cells Ph^1 chromosomes were present in all CGL cases, with a frequency of 62 to 100% in the cells. No positive correlation was found between NAP and Ph^1 chromosome frequency. No relation was observed between peripheral white blood cell count or therapeutic effects and presence of the Ph^1 chromosome. In three of the 15 cases, blast cell counts rose and chromosomal analysis showed an increase in aneuploid cells and additional aberrations of the other chromosome. One patient had 219 chromosomes and the karyotype revealed double Ph^1 chromosomes. This occurrence was discussed in relation to 13 cases of double chromosomes found in the literature and the cytogenetic changes following blast cell crisis in CGL. In 28 patients with acute leukemia, abnormal karyotypes were observed in 10 cases. A modal chromosome count other than 46 was found in five cases (three hypodiploid and two hyperdiploid). In most cases of acute granulocytic leukemia (AGL), the NAP value was high, but in six out of 19 cases it was low. Two patients showed an abnormal karyotype in which a chromosome was missing in group G. The absence of both chromosomes in group G and a low NAP value in some AGL patients were correlated with the presence of the Ph^1 chromosome and low NAP activity in CGL patients. The possibility of a correlation between a group G chromosome and NAP gene locus was considered. (BBB)

10007 SCREEN STOPS RADIATION. [RADIATION ANTIDOTE). Rom. Today, No. 12, 56(1967). (In Rumanian).

A group of Rumanian radiobiologists recently discovered a safe chemical antidote for radiation called imipramine. Minute laboratory tests on thousands of animals showed that in over 80 per cent of the cases, organisms treated with imipramine survived lethal doses of radiation. The properties of the new chemical internal antidote are similar to those of AET, the strongest radiation-protecting substance in the world, but imipramine has the advantage of not being toxic. (JPRS)

10008 SURVIVAL OF LETHALLY IRRADIATED MICE TRANSFUSED WITH LIVING PHYTOHEMAGGLUTININ-STIMULATED SYNGENEIC THYMOCYTES. Schneiberg, Krzysztof; Jonecko, Antoni; Szymaniec, Stanislaw; Bartnikowa, Wieslawa (Inst. of Oncology, Gliwice, Poland. Inst. of Immunology and Experimental Therapy, Wroclaw). Arch. Immunol. Ther. Exp., 16: 732-41(1968).

Syngeneic thymus cells injected intravenously in doses of 3×10^5 viable cells enabled about 20% of mice previously irradiated with lethal marrow doses (800 R on the whole body) of x rays to survive. Only those thymus cells exhibited therapeutic activity that were incubated in vitro with phytohemagglutinin before injection. Thymocytes not stimulated before injection had no therapeutic effect. Hence, lymphocytes, or at least some cells of this type, under certain conditions exhibit properties of bone marrow precursors. The manifestation of these properties takes place after prior lymphoblastoidal transformation. (auth)

10009 RELATIVE RADIOPROTECTIVE ABILITIES OF 5-HYDROXYTRYPTOPHAN AND 5-HYDROXYTRYPTAMINE. Barnes, J. H.; Lowman, Doreen M. R. (Medical Research Council, Harwell, Eng.). Int. J. Radiat. Biol., 14: 87-8(1968).

The relative radioprotective effects of 5-hydroxytryptophan and 5-hydroxytryptamine on the survival of x-irradiated mice were compared. Treatment with 5-hydroxytryptamine gave better survival than treatment with 5-hydroxytryptophan, and the survival of all treated mice was significantly higher than that of untreated controls. (C.H.)

10010 INFLUENCE OF CYSTAMINE AND MEXAMINE ON CERTAIN INDICES OF HEMOSTASIS IN IRRADIATED RATS. Vorob'ev, S. Ya.; Gracheva, A. I.; Rudakov, I. A.; Khnychev, S. S. (Inst. of Experimental Pathology and Therapy, Moscow). Med. Radiol., 13: No. 11, 64-7(Nov. 1968). (In Russian).

The results of studying the influence of prophylactic administration of cystamine (110 mg/kg) and mexamine (25 mg/kg) on hemostasis indices of Wistar rats irradiated in a dose of 600 R are reported. A disturbance of morphological and functional properties of thrombocytes, reduction of the quantity of megakaryocytes and thrombocytes, and affection of a number of other hemostatic indices in protected rats were less severe than in nonprotected animals. Cystamine and mexamine are endowed with approximately the same radioprotective effect. (auth) (C.O.)

10011 DIAGNOSTIC RADIOLOGY IN RELATION TO THE MENSTRUAL CYCLE. Ellis, Frank (Churchill Hospital, Oxford). Brit. J. Radiol., 41: 877-8(Nov. 1968).

In view of the knowledge of the radiosensitivity of the developing human ovum and fetus, the public health considerations in x irradiation of women for diagnostic purposes are discussed. Diagnostic radiology should be so arranged that it does not occur after the 10th day of the menstrual cycle. Necessary exceptions and legal consequences are also considered. (C.O.)

10012 CHANGES IN THE COURSE OF RADIOINDUCED MITOTIC INHIBITION BY THE ADDITION OF NICOTINIC ACID DERIVATIVES. Kaufmann, H.; Tiemann, W.; Bartholomae, H.-J. (Ruhr Univ., Bochum, Ger.). Radiol. Clin. Biol., 37: 141-8(1968). (In German).

The prolongation of the radioinduced mitotic depression of tumor cells in cultures by complamin was shown for a wide dose range. This prolongation of the mitotic depression was the same when complamin was given before or after exposure to ionizing radiation. When complamin was given shortly before radiation, the mitotic depression (I. phase) was slower than with complamin given after

radiation, or with irradiation without complamin. This effect is possibly caused by a diminution of the radioinduced depression of NAD and ATP synthesis during the last phase of intermitosis. (auth)

10013 INFLUENCE OF TOTAL SINGLE PRELIMINARY X IRRADIATION ON RECOVERY OF LOST BLOOD VOLUME IN RABBITS. Movesyan, M. A. Vop. Radiobiol., Sb. Tr., 5: 291-301(1965). (In Russian).

The experiments show that at the first, third, and fourth stages of severe radiation sickness the limit of compensatory — recovering capacity of cardiovascular system is reduced and the character of compensatory-recovering reactions is broken. After bloodletting (30% of the total circulating blood volume) the volume of the blood lost by irradiated rabbits is compensated at the expense of the intercellular lymph inflow into the vessel. In some cases neither compensation nor recovery is observed and the animal dies. (auth)

10014 PROPHYLACTIC ADMINISTRATION OF HYALURONIC ACID IN CASE OF EXPERIMENTAL RADIATION SICKNESS. Airapetyan, F. O. Vop. Radiobiol., Sb. Tr., 5: 281-4(1965). (In Russian).

Experiments on 640 white mice show that in irradiated animals (800 R) both vitreous body and umbilical hyaluronic acid increase their survival rate. Although such (parenteral) prophylactic administration of the above preparations protects the body from pernicious effect of x rays, it may not be considered satisfactory. (auth)

10015 SUSCEPTIBILITY OF WHITE MICE TO VACCINE VIRUS IN CONDITIONS OF TOTAL X IRRADIATION. Vartevanyan, Zh. Ts. Vop. Radiobiol., Sb. Tr., 5: 197-203(1965). (In Russian).

Experiments on 442 white mice to study their susceptibility to vaccine virus in conditions of x irradiation are described. The results obtained show that preliminary and further x irradiation (400 and 600 R) drastically increase the death rate of white mice whose brain is virus vaccinated. The above irradiation is also reported to favor a longer virus survival in the body. (auth)

10016 RESPONSE OF THE VACCINE-IMMUNE BODY TO X IRRADIATION. Kamalyan, L. A.; Ter-Pogosyan, R. A.; Vartevanyan, Zh. Ts.; Engoyan, M. N. Vop. Radiobiol., Sb. Tr., 5: 13-17(1965). (In Russian).

Experiments on rabbits show the possibility of applying anti-small-pox immunization as a means of increasing the animals resistance to the x-ray irradiation dose of LD-50. Radiation resistance of the immune rabbits is revealed by their increased survival rate, by the milder course of radiation sickness and by less severe bacteremia. Irradiation of the immune rabbits brings about a partial loss of immunity which is indicated by positive skin response to vaccine and by the decrease of the antibody titre. (auth)

10017 EXAMINATION OF ANTI-SMALL-POX IMMUNITY AND OF CERTAIN ASPECTS OF PROTEIN METABOLISM IN X IRRADIATED RABBITS UNDER THE CONDITION OF ETHANOLAMINE ADMINISTRATION. Papoyan, S. A.; Kamalyan, L. A.; Ter-Pogosyan, R. A.; Buniatyan, L. O.; Engoyan, M. N. Vop. Radiobiol., Sb. Tr., 5: 29-37(1965). (In Russian).

Under the condition of x-ray irradiation (600 R) followed by vaccination, the death-rate of experimental animals increased and the development of autoinfection processes was observed to occur more frequently. Irradiation depressed the synthesis of anti-hemagglutinins and antibodies neutralizing viruses. A single administration of ethanolamine made no effect upon antibody production. Irradiation disturbed protein metabolism which was indicated by electrophoretic examination and by determination of free acids in the blood serum. (auth)

10018 CHARACTERISTIC OF ENDOGENIC INFECTION IN IRRADIATED MICE IN CONDITION OF MONOETHANOLAMINE ADMINISTRATION. Ter-Pogosyan, R. A.; Kamalyan, L. A. Vop. Radiobiol., Sb. Tr., 5: 45-51(1965). (In Russian).

Bacteremia in x irradiated mice (600 and 800 R) develops on the 3rd day and lasts until the 26 to 30th day, the frequency of bacteremia increasing with the increase of the irradiation dose. Bacterium coli and cocci flora are most often in the blood. Monoethanolamine, injected subcutaneously (2 mg) prior to irradiation (600 R), decreases frequency of occurrence and duration of bacteremia in irradiated mice. Intraabdominal injection of monoethanolamine considerably relieves the course of autoinfection process in mice irradiated by the above dose. (auth)

10019 RESPONSE OF THE SPLEEN TO SUSPENSIONS OF MARROW TRANSPLANTED INTO IT. Ogandzhanyan, E. E. Vop. Radiobiol., Sb. Tr., 5: 53-61(1965). (In Russian).

Some changes taking place in the spleen in response to isologic marrow transplanted into it are examined. The marrow was transplanted into black mice of C 57/6 strain 24 hours after a single total irradiation (600 R). The marrow was not transplanted into a control group of animals after irradiation. The results obtained show that marrow transplantation into the spleen of the irradiated mice produces a significant effect on the spleen hemopoiesis. While in the control group of mice an appreciable increase of the cell mitotic activity occurs on the 14th day after irradiation, intraspleen transplantation of the marrow brings about an intense hemopoiesis on the 10th day of radiation sickness. On the other hand, combination of marrow transplantation with prophylactic administration of 0.1 cm^3 of 2% oil solution of synestrol, 7 days prior to irradiation, an intense regeneration of blood forming elements in the spleen is observed on the 5th day after marrow cells have been transplanted into it. (auth)

10020 THERAPEUTIC POTENTIAL OF MUCOPOLYSACCHARIDES IN CERTAIN CASES OF RADIATION LESION. Alaverdyan, M. I.; Airapetyan, F. O. Vop. Radiobiol., Sb. Tr., 5: 69-74(1965). (In Russian).

The vitreous body is found to possess a distinct protective effect, revealed in experimental radiation sickness. Both the vitreous body hyaluronic acid and that obtained from navel strings of the newborns possess therapeutic and therapeutic-prophylactic activity. If the above substances are administered to white mice during 10 days before and after irradiation, the survival rate of these animals is 1.9 higher than that of the untreated animals. (auth)

10021 QUANTITATIVE CHANGES IN BLOOD CELLS AND HEMOPOIETIC SYSTEM OF IRRADIATED WHITE MICE IN THE CASE OF COMBINED INJECTION OF SYNESTROL AND MARROW. Pareishvili, E. A. Vop. Radiobiol., Sb. Tr., 5: 109-18(1965). (In Russian).

Five hundred irradiated white mice were divided into two groups. Seven days before irradiation, the experimental group of mice were prophylactically injected with 2% oil solution of synestrol, 0.1 cm^3 to each mice; 24 hours after irradiation marrow emulsion was injected into the spleen (four hip equivalents per one mouse). The controls were not treated. The peripheral blood, reticulocytes and quantitative changes in the hemopoietic system (the marrow and the spleen) were examined on the 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23rd days of the marrow injection. The experimental results show that the above treatment increases the survival rate from 30 to 78% and stimulates hemopoiesis as well. All the data on the blood and hemopoietic system for the experimental group of mice show higher figures, starting from the 5th day of the experiment. (auth)

10022 IODINATED TOLUIDINE BLUE: A POTENTIAL AGENT FOR PARATHYROID SCANNING. Brien, T. G.; Keaveny, V. (University Coll., Dublin). Int. J. Appl. Radiat. Isotop., 19: 820-1(Nov. 1968).

The results obtained using ^{75}Sc-selenomethionine for parathyroid scanning have been described as encouraging but frustrating, and it has been suggested that "real progress in the scanning of these glands will depend on the discovery of a more suitable radioactive compound." The use of iodinated Toluidine Blue O, as such a compound, is suggested. (auth)

10023 POSSIBILITIES FOR PROTECTION AND REPAIR OF IRRADIATED DNA AND RNA WITH RESPECT TO THEIR DNA/mRNA-HYBRID-FORMING ABILITY. Robev, S.; Marinova, Z.; Petrova, S. (Inst. of Radiology, Sofia). Compt. Rend. Acad. Bulg. Sci., 21: 933-6(1968).

Starting with two strains of Escherichia coli (hcr^- and fil_1^-) that differed in their reaction to uv radiation, it was determined that DNA and RNA isolated from either of them manifested similar patterns of radiosensitivity. Therefore a further study on repair of uv damage was made with only one (fil_1^-). Experimental data showed a well-defined repair effect of Micrococcus lysodeicticus enzyme extract on irradiated double stranded E. coli DNA. In non-repaired samples uv radiation provoked about 50% suppression of DNA/RNA hybrid formation, while those treated after irradiation with enzyme extract showed almost complete restoration of their hybridizing ability to isologous mRNA. Chemical radioprotection with cysteamine was attempted with both DNA and mRNA. The data revealed a similar profile of protection efficiency of cysteamine on the radiosensitivity of either of the two nucleic acids hybridizing with each other. (H.L.W.)

10024 ISOTOPE SCANNING OF BRAIN TUMORS USING ^{99m}Tc. Filson, J. F.; Rodriguez-Antunez, A. (Cleveland Clinic Foundation). Acta Radiol., Diagn., 7: 380-4(1968).

Brain scanning after administration of ^{99m}Tc was performed in 97 patients, all with intracranial tumors proved at biopsy. The isotope appears to be ideal for scanning because of the low radiation dose to the patient and the high counting rate obtained. Authors believe that the statistics of scanning may be improved by

the use of this isotope and an 8-inch crystal rectilinear scanner and thus make rapid linear brain scanning feasible. The overall diagnostic accuracy was 90 percent in the series reported upon. (Sweden)

10025 MODIFICATION OF ACUTE RADIATION INJURY IN MICE BY TRANSFUSIONS OF LIVING LYMPHATIC CELLS. Schneiberg, Krzysztof; Jonecko, Antoni; Bartnikowa, Wieslawa; Szymaniec, Stanislaw (Inst. of Oncology, Gliwice, Poland. Inst. of Immunology and Experimental Therapy, Wroclaw). Arch. Immunol. Ther. Exp., 16: 605-17(1968).

Intravenous injection of xenogeneic (rat) lymphocytes in doses of 4×10^5 viable cells in mice previously irradiated with lethal marrow doses (800 R on the whole body) of x rays enabled the animals to survive the acute post-radiation phase. Later, the animals died from secondary disease. Syngeneic lymphocytes did not produce a similar effect. The therapeutic effect of allogeneic lymphocytes was stronger than that of syngeneic cells, but weaker than after cells from a different species. Dead lymphatic cells, pure DNA, and anionic polymers were therapeutically inactive. On the basis of these data, the hypothesis was formulated that the therapeutic influence of lymphatic cells in irradiated animals is caused by the ability of these cells to undergo transformation into precursors of the bone marrow system, especially granulocytes. An essential condition for the manifestation of this phenomenon is prior stimulation of the lymphocyte to transformation into other, nonlymphatic, cell types. (auth)

10026 ANSWER TO THE AEC ON ^{197}Hg–CHLORMERODRIN. Blau, Monte (Roswell Park Memorial Inst., Buffalo). J. Nucl. Med., 9: 206-7(May 1968).

Mercury-203-labeled chlormerodrin was removed from the list of medical uses by the AEC Advisory Committee on Medical Uses of Isotopes. It was recommended by the Committee that ^{197}Hg-chlormerodrin be used on the basis of the harmful effects of the higher radiation dose of ^{203}Hg to the kidney. It is stated that the dose of ^{203}Hg to the kidney was miscalculated by the AEC Committee. In view of the fact that a much better diagnosis can be obtained with ^{203}Hg it is recommended that the AEC return to ^{203}Hg-chlormerodrin for kidney scanning. (H.L.W.)

10027 ERYTHROCYTES AS A MODEL FOR STUDYING RADIOTOXINS AND CHEMICAL RADIOPROTECTORS. Kakushkina, M. L.; Kudryashov, Yu. B.; Baltbardzis, Z. Ya.; Dmitrieva, N. G.; Slava, E. E.; Filenko, O. F. pp 239-45 of Voprosy Biofiziki, Biokhimii i Patologii Eritrotsitov. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

A radioinduced lipid toxin was found to be one of the most important toxin compounds in the primary development of radiation injury. This lipid substance, taken from tissues of irradiated animals, was an unsaturated fatty acid of the oleic type or a product of its oxidation. Human erythrocytes were used for investigating the effects of radiotoxins and chemical radioprotectors. Erythrocytes are a convenient model because they are readily available in a free and uninjured state, and also because the physical and chemical properties of their stroma are similar to other biological structures. The presence of pigment in erythrocytes facilitates detection of any cell damage with photoelectrocalorimetric methods. Prior to experimentation, the erythrocytes were washed, and the oleic acid was oxidized in an air flow at 60°C. Tissue lipids were ether extracted and purified from peroxides, and then the phospholipids were precipitated with acetone. Erythrocyte resistance was determined by erythrograms. Radioprotectors were dissolved in a physiological solution and added to the erythrocytes just before the oleic acid was introduced. The first group of experiments showed that the hemolytic activity of oleic acid depends to a certain degree on its fixation on the structural components of the erythrocyte and on its oxidation. A second group of experiments was conducted to determine the hemolysis-inhibiting action of certain types of radioprotectors including amine thiols, phospholipids, and polysaccharides. The inhibiting action of these radioprotectors on oleic acid hemolysis differed. The protective effect of equimolar concentrations of mercamine increased with higher concentrations of oleic acid; mercamine primarily reduced the maximum limit of hemolysis. The phospholipids and the polysaccharides affected the rate of hemolysis; apparently, they compete with oleic acid during its adsorption and bind this acid into inactive complexes. With irradiation of erythrocytes in the presence of an oleic acid emulsion, the hemolytic reaction rate increased, and in some cases was higher than for the total action of irradiation followed by the addition of oleic acid. In previously irradiated cells, radiation injury was greatly intensified with subsequent addition of oleic acid. With irradiation of cells in the presence of oleic acid, certain active, short-lived intermediate products of oxidation apparently are formed, inducing cell injury. Inhibitors of oleic acid hemolysis in erythrocytes displayed the same degree of effectiveness when used as radioprotectors in irradiated animals. For in vitro experiments, no single model in itself is adequate for evaluating the effectiveness of a given radioprotector. Erythrocyte reaction used together with other models is a simple, convenient method for conducting a large number of experiments to provide accurate quantitative analysis of results. (auth)

10028 OUR METHOD OF LUNG PROFILE SCANNING. Sasamoto, Hiroshi; Sekimoto, Toshio (Keio Univ., Japan). Radioisotopes (Tokyo), 17: 533-8(Nov. 1968). (In Japanese).

Various radioisotopes such as ^{131}I-MAA, ^{113m}In–Fe(OH)$_3$, ^{133}Xe, ^{85}Kr were generally used to study regional function of lungs. A lung profile scanning technique using ^{131}I-MAA was devised to study regional pulmonary blood flow. In this report, equipment for lung profile scanning was demonstrated and basic problems of this method were discussed, and application of this method to radioactive gases was also presented. Bilateral lungs were separately scanned in longitudinal direction, i.e., from the apex to the base over the posterior wall of the chest. This apparatus equipped with 2 inch sodium iodide crystal detectors and tapered collimators had a driving unit in combination with an induction motor and gears, and two pre-setting markers indicating a localization of collimator against the lung area. Scintillation pulses were recorded through ratemeter system on the running paper with the same speed as its scanning speed. In order to obtain the ideal distribution curve of isotope, the fundamental properties of the linear scanning propose to determine the optimal relationship of a time constant to scanning speeds. Scanning shift and decreased peak value of pulmograms were used as the indicators for elucidating this relation. The study indicated that optimal relation between scanning speeds and time constants was as follows; when time constant was 0.5 sec, its optimal scanning speed was 20 mm/sec or less, and when time constant was 1.0 sec, its optimal speed was 5 mm/sec or less, respectively. In lung profile scanning with low energy γ-emitters such as ^{133}Xe, the lung should be scanned simultaneously with two collimators, anteriorly and posteriorly. (NSA of Japan)

10029 AUTOGRAFTS OF BONE MARROW IN SWINE GIVEN LETHAL DOSES OF RADIATION. Vaiman, M.; Dubiez, R.; Colson, X.; Nizza, P. (Commissariat a l'Energie Atomique, Jcuyen-Josas, France). Int. J. Radiat. Biol., 14: 207-24(1968). (In French).

A technique of taking bone marrow samples from swine weighing about 60 kg is described. In this surgical technique, the marrow is removed by curettage of the spongy bone, the selected points being the crista iliaca, the first sternebrae, or the proximal epiphysis of the tibia. It offers a number of quantitative and qualitative advantages. The animals withstood the operation very well. Preliminary results are reported of autografts of bone marrow in swine following exposure to ^{60}Co γ radiation at lethal or supralethal doses (375, 400, 600, and 800 rads at the sagittal level). The autografts were performed just after the exposure. The amount of injected medullary cells ranged between 2 and 4×10^9. The first results showed that 5×10^7 medullary cells per kg of body-weight were sufficient to induce the recovery of a swine irradiated in toto with 600 rads and still allowed survivals at 800 rads. (auth)

10030 THERAPEUTICS FOR PROTECTING RADIATION-INDUCED HEMATOPATHY. PART 1. Soeda, Momoe (Tech. Research and Development Inst., Japan). Giho (Boeicho Gijutsu Kenkyu Honbu), 7: No. 58, 19-28(Jan. 1968). (In Japanese).

The protective effect of marimycin, an antibiotic isolated from the culture medium of Streptomyces mariensis, against leucopenia was examined in irradiated mice. The greatest protective effect was obtained in a dose of 1.25 to 2.5 mg/kg, while the toxicity of marimycin was about 200 mg/kg in mice, thus permitting a wide range of safety. Marimycin was also found to have a leucocytotic effect in a range of 0.8 to 2.0 mg/kg in rabbits. In this dose range, marimycin had a marked protective effect against leucopenia induced by irradiation or by anticancer agents. Administration of a small effective dose of marimycin allowed its repeated application without causing any side effects. The possibility of the use of a small dose of marimycin contrasted with other chemical protective agents whose therapeutic dose was in the range of 100 to 1000 mg/kg, with the exception of serotonin which was used in 4 mg/kg dose. The protective effect of marimycin was considered to be due to leucocytosis which might be the secondary result of stimulating the leucocytotic mechanism, as yet uncertain at present. It seemed reasonable to consider that marimycin effected a trigger action on leucocytosis, from its small effective dose compared to other chemical protective agents. (NSJ)

10031 THERAPEUTICS FOR PROTECTING RADIATION-INDUCED HEMATOPATHY. PART 2. Soeda, Momoe (Tech. Research and Development Inst., Japan). Giho (Boeicho Gijutsu Kenkyu Honbu), 7: No. 58, 29-38(Jan. 1968). (In Japanese).

Clinical trial of marimycin was carried out on 21 cases with various malignancies. A daily dose of 20 to 40 mg was administered by subcutaneous injection during the period of radiotherapy in which telecobalt γ irradiation of 200 R was given 10 to 70 times (14,000 R) regularly to one or more portals. The protective effect of marimycin on radioinduced leucopenia was generally observed in these clinical cases. There was no occasion to interrupt the radiotherapy due to the fall of the white cell count below 3,000 that was experienced in control cases. Moreover, the recovery was found to be faster in treated cases. No side effects or intoxication due to medication was encountered. The safety and effectiveness of the use of this antibiotic for protection against radioinduced hematopathy was strongly emphasized. (NSA of Japan)

10032 RAPID SEQUENTIAL RENAL SCANNING. Hayes, Michael; Swanson, Leonard A.; Taplin, George V. (Los Angeles County Harbor General Hospital, Torrance, Calif. Univ. of California, Los Angeles). Contract AT(04-1)-Gen-12. Radiology, 91: 984-90(Nov. 1968).

Useful kidney scans may be obtained in two minutes with a ten-probe scanner. A series of such scans begun immediately after injection of 500 to 800 μCi of either ^{131}I-iodohippurate or ^{131}I-iothalamate provides a graphic representation of the dynamics of intrarenal transport of these radio-urographic agents, revealing information of functional and anatomic significance. The first scans in a normal study show activity mostly within the renal cortex and demonstrate the functional size of the kidneys. Later, tracer activity moves into the calyces and pelvis. The distribution of ^{131}I-iodohippurate, which is rapidly cleared by a combination of glomerular filtration and tubular excretion emphasizes renal function. The pharmacodynamics of ^{131}I-iothalamate are similar to those of the popular conventional urographic contrast media, such as diatrizoate and iothalamate, which are cleared by glomerular filtration alone. A scan series may help differentiate unilateral renal artery occlusive disease from partial urinary obstruction. It may serve as a substitute for intravenous pyelography in patients allergic to urographic material, and it can visualize kidneys in severely azotemic patients. Rapid sequential renal scanning is a safe, reliable, easily performed procedure which provides useful supplemental information to the intravenous urogram. (auth)

10033 IOTHALAMATE ^{131}I RENOGRAPHY. CLINICAL EXPERIENCE AND COMMENTS ON THE VALIDITY OF THE TECHNIQUE. Giavelli, S.; Zucali, R. (Univ., Milan. Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan). Acta Isotop., 7: 299-314(Dec. 30, 1967). (In Italian).

The results obtained in renography using ^{131}I-iothalamate were discussed. Iothalamate, which is nontoxic and chemically stable, gave renograms in which the first and second phases were significantly modified in cases with vasculo-glomerular involvement. Iothalamate renography gave accurate findings on kidney function in patients affected with hypertension, even when renal function tests and radiohippuran renography did not show any pathological change. (auth)

10034 ENDOTOXIN, EPINEPHRINE, AND ELLAGIC ACID EFFECTS ON THE RADIATION-SENSITIZED WALKER 256 RAT CARCINOSARCOMA. Contreras, Ma. de los Angeles; Bale, William F. (Univ. of Rochester, N. Y.). Radiat. Res., 36: 166-79(1968). (UR-49-809).

A radiation exposure of 1500 R of γ rays to the Walker 256 rat tumor sensitized this tumor to the effect of a sublethal dose of endotoxin (Serratia marcescens lipopolysaccharide) given two days later so that complete or almost complete destruction of the tumor resulted. Histological study showed rapidly developing massive necrosis of tumor tissue. Tracer experiments with ^{131}I-labeled antibody to rat fibrin indicated an absence of blood circulation in the treated tumor. These results suggested that the lesion was secondary to blood coagulation occurring in the vascular bed of the tumor. Apparently identical lesions were also produced by epinephrine and ellagic acid, alone or in combination. It is known that even untreated tumors are often the site of fibrin deposition. Presumably radiation, by injury to tumor cells, enhanced the release of coagulation-producing substances into the vascular bed. It is postulated that the effect of subsequent treatment with the drugs listed above is produced by circulatory stasis induced in the tumor. This may be associated with Hageman factor activation or release of platelet factor 3. (auth)

10035 PROPRANOLOL AND ^{131}I IN THE MANAGEMENT OF THYROTOXICOSIS. Hadden, D. R.; Montgomery, D. A. D.; Shanks, R. G.; Weaver, J. A. (Royal Victoria Hospital, Belfast. Univ. of Belfast). Lancet, 2: 852-4(Oct. 19, 1968).

Seventeen patients with thyrotoxicosis were treated with relatively small doses of ^{131}I and their thyrotoxic symptoms were controlled with propranolol. This use of propranolol, which does not interfere with thyroid-function tests, may allow an earlier and better differentiation of those patients who will respond effectively to a small dose of therapeutic radioactive iodine. (auth)

Radiation Effects on Animals

Refer also to abstract 10126.

10036 ON THE INFLUENCE OF CELL ABNORMAL GROWTH ON CRYPT CELL POPULATION KINETICS IN IRRADIATED INTESTINAL EPITHELIUM. Kononenko, A. M. (Central Research Inst. of Roentgenology and Radiology, Leningrad). Tsitologiya, 10: 1425-31(Nov. 1968). (In Russian).

A study of the intestinal epithelium kinetics of the cell population level cannot answer the question about the causes of some kinetic phenomena, since in relation to the latter any investigation at this level cannot be otherwise than phenomenological. It is not possible to answer the question, for example, why the movement of cells from the crypts to the villi plays an important role in the depopulation of irradiated crypts and why this self-stabilizing system, represented by the crypt cell population, stabilizes itself after irradiation by such a small number of cells. The cause of this phenomenon probably can be found at a lower level in investigations on changing the biomass of the whole crypt and single cells, because the steady state of the crypt cell population is determined in the end by equilibrium between the flows of substance into the crypt and out of it. Postirradiation decrease in the number of the crypt cells is not followed by the same decreasing of the crypt biomass due to the abnormal growth of irradiated cells. A detailed and comparative experimental study of changes in the number of the crypt cells, their mitotic activity in the crypt, and single cell biomasses occurring within 72 hours following total single x irradiation of mice (700 and 900 rad) is presented. It is shown that the appearance of the second wave of the cell movement to the villi from the crypts depopulated to a considerable extent by irradiation does not contradict the conception about pushing the cells out of the crypts to the villi, because the cells are growing abnormally. Since the substance does not stop entering the crypts after irradiation, an inevitable consequence of that must be the flow of substance and the movement of the cells to which this substance is discreted from the crypts. (auth)

10037 EFFECT OF ROENTGEN IRRADIATION ON WHITE BLOOD CELLS. Majupuria, K. C.; Gupta, L. C.; Gupta, M. C. (Medical Coll., Gwalior, India). Indian J. Radiol., 20: 150-1 (1966).

Twenty five patients suffering from carcinoma of various organs comprised the material for study. Peripheral blood smears were made before and after x irradiation over long periods and at frequent intervals. It was found that lymphocytes were the most sensitive cells of all leukocytes. (Indian Sci. Abstr.)

10038 RADIOSENSITIVITY OF BONE MARROW STEM CELLS. 2nd REPORT. ENDOGENOUS SPLEEN COLONY METHOD. Tanaka, Yoshimasa; Kuroda, Yasumasa (Tenri Hospital, Nara, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1418-24(Feb. 1968). (In Japanese).

In this experiment, the endogenous colony method was employed. This method is based on the finding that mice irradiated with whole body radiation doses in the range from 500 to 800 rads develop microscopically visible colonies of cells in the spleen within about 10 days after irradiation. The histological examination of these colonies and dose survival curve in relation to ^{59}Fe uptake by spleen were studied. We also examined the RBE of 18 MeV electron beam versus 200 kVp x rays, the problem of early or late repair, and the protective effect of AET by this endogenous colony technique. The results were as follows: The number of colonies and ^{59}Fe uptake by spleen were decreased exponentially from 550 to 750 R and the radiosensitivity of endogenous colony forming cells was similar to that of transplanted colony forming cells. The RBE of 18 MeV electron beam versus 200 kVp x ray were 0.77 on the number of spleen colonies and 0.89 on ^{125}IUdR uptake by spleen. The initial maximum of recovery in the early repair process took place at about 5 hours after the first dose fraction, followed by an intermediate minimum at about 10 hours. In the late repair observed when the time interval between the dose fractions was over 24 hours, larger total doses were required to produce the same level of surviving endogenous colony-forming cells as the time interval between the dose fractions increased. The protective effect was found on the dose range from 500 to 750 R when AET (150 mg/kg) was intraperitoneally injected. (NSA of Japan)

Invertebrates

Refer also to abstracts 9852, 9920, 9923, 10012, 10095, 10108, and 10149.

10039 (NYO-2043-173, pp 52-7) TRITIATED THYMIDINE AUTORADIOGRAPHY USED TO STUDY THE RATE OF SPERMATOGENESIS OF THE BLOW FLY, PHORMIA REGINA. Katiyar, K. P. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The rate of spermatogenesis and the effects of γ radiation on production of sperm were studied in blowflies (Phormia regina). Adult male blowflies were injected with ^{3}H-thymidine, divided into five groups, and maintained in temperature-controlled cabinets (27°C). Twenty-four hrs after labeling, groups two and three were γ-irradiated at doses of 800 and 8000 rads, respectively, at a dose rate of 2700 rads/min. Groups four and five received the same treatment on the fourth day following injection. Group one was not irradiated so that normal spermatogenesis could be studied. Flies from all groups were sacrificed at 24 hr intervals for 12 days (longer than required for normal spermatogenesis) and autoradiograms prepared. Results indicated that: 800 rad doses of γ rays were lethal to most spermatogonia and spermatocytes; 8000 rad doses were 100% lethal; and thymidine was not incorporated at the site of DNA synthesis in the spermatogonial cysts, probably prevented by the fatty tissue sheath around the testes. (E.R.B.)

10040 BEHAVIOR OF IRRADIATED BOLL WEEVILS. I. FEEDING, ATTRACTION, MATING, AND MORTALITY. Bartlett, Alan C.; Hooker, P. A.; Hardee, D. D. (Dept. of Agriculture, State College, Miss.). J. Econ. Entomol., 61: 1677-80(Dec. 1968).

The feeding activity, mating frequency, attraction, sexual response, and mortality of normal Anthonomus grandis Boheman were compared with boll weevils irradiated with 6,388 or 12,775 rad of ^{60}Co γ radiation. The irradiated weevils equaled normal weevils in each aspect of behavior for at least 5 days posttreatment. However, by the 7th day posttreatment, all these activities had started to decline in the treated weevils and all irradiated weevils were dead by the end of the 2nd week. Thus, irradiated boll weevils may be effective in a program involving the release of sterile insects, but the releases would have to be made at least weekly and preferably every 5 days. (auth)

10041 SUB-LETHAL GAMMA RADIATION EFFECTS ON PREPUPAE, PUPAE, AND ADULTS OF ANGOUMOIS GRAIN MOTH. Qureshi, Zafar A.; Wilbur, D. A.; Mills, R. B. (Kansas State Univ., Manhattan). J. Econ. Entomol., 61: 1609-1705 (Dec. 1968).

Effects of γ radiation from ^{60}Co on prepupae, pupae, and adults of Sitotroga cerealella (Olivier) were determined. Pupal sensitivity depended on age at treatment; the older the pupae, the less susceptible. Irradiation of prepupae and 1-day-old pupae resulted in reduced numbers, delayed and incomplete adult emergence, and in structural deformities including twisted wings and fusion of tarsal and antennal segments. No dose tested on late pupae significantly affected adult emergence. Larvae hatched from the eggs of irradiated 1-day-old adults, but the number of F_1 moths was less than in the controls. Females, irradiated at 10 kR as prepupae and mated with normal virgin males or vice versa, either did not oviposit or laid infertile eggs. Irradiation of early pupae at 20 kR may cause complete sterility of both sexes. Following irradiation of late pupae, no dose from 5 to 25 kR prevented hatching of eggs in crosses where treated males were mated to untreated females or vice versa. When males and females, irradiated as 1-day-old moths, were mated, egg deposition and hatchability were markedly reduced. The males remained fertile at all doses. (auth)

10042 BEHAVIOR OF IRRADIATED BOLL WEEVILS. II. REPRODUCTION AND MORTALITY IN CAGES WITH UNTREATED BOLL WEEVILS. Bartlett, Alan C. (Dept. of Agriculture, State College, Miss.). J. Econ. Entomol., 61: 1680-4(Dec. 1968).

Mortality, egg production, and egg hatch were determined for female Anthonomus grandis Boheman which had been treated with 6388 or 12,775 rad of ^{60}Co γ irradiation and confined in various ratios with treated and/or untreated male and female weevils of the same age and strain. Both treatments sterilized the weevils, but egg hatch was reduced only when the ratio of treated (T) to normal (N) male weevils exceeded 10T : 1N. When the treated group consisted of males only or males and females and the ratios were 20T : 1N or 100T : 1N, hatch was reduced. However, groups of treated females only had no effect on hatch at any ratio of treated to normal weevils. In a 35-day test, 4 weekly releases of irradiated weevils to maintain a cage population ratio of 100T : 1N caused a reduction in hatch ranging between 70 and 90%. (auth)

Vertebrates

Refer also to abstracts 9754, 9827, 9831, 9836–9840, 9842, 9848, 9850, 9853, 9855, 9856, 9859, 9868–9874, 9876–9879, 9882, 9884, 9885, 9889, 9891–9893, 9895, 9897, 9903, 9908, 9916, 9961, 9969–9971, 9975, 10007–10010, 10014–10019, 10025, 10029, and 10030.

10043 (BNL-12950) RADIATION MORTALITY IN DIFFERENT MAMMALIAN SPECIES. Bond, V. P. (Brookhaven National Lab., Upton, N. Y.). [1968]. 29p. (CONF-680518-4). Dep. CFSTI.

From Conference on Comparative Cellular and Species Radiosensitivity in Animals, Kyoto, Japan.

The LD_{50} values for death from the bone marrow syndrome, expressed in terms of absorbed γ-dose in tissue, are given for a number of mammalian species. These include man, burros, dogs, goats, guinea pigs, hamsters, mice, monkeys, rabbits, rats, and swine. It is pointed out that while hematologic changes are qualitatively similar in all the species studied, substantial variation was seen with respect to the relative contribution of changes in the several elements to illness and mortality. (20 references.) (C.H.)

10044 (BNL-12951) GASTROINTESTINAL SYNDROME. Bond, V. P. (Brookhaven National Lab., Upton, N. Y.). May 1968. 19p. (CONF-680518-5). Dep. CFSTI.

From Conference on Comparative Cellular and Species Radiosensitivity in Animals, Kyoto, Japan.

The gastrointestinal syndrome is defined as the complex of symptoms that culminate in death following exposure to whole-body irradiation. It follows exposure to large doses of radiation and is characterized by a relatively short survival time. Possible mechanisms involved in the syndrome, including the role of partial-body irradiation, bone marrow depression, and infections are discussed briefly. Data are presented on the doses of γ- and x radiation necessary to induce death with the gastrointestinal syndrome for mice, rats, dogs, monkeys, rabbits, guinea pigs, hamsters, goats, burros, and man. (C.H.)

10045 (NP-17514) RADIATION BIO-EFFECTS. Summary Report, January–December 1967. Hodge, Donald M. (comp. and ed.) (National Center for Radiological Health, Rockville, Md.). 119p.

Separate abstracts were prepared for six sections of this report. Activities of the various laboratories of the National Center for Radiological Health are described. (H.L.W.)

For abstracts of individual sections see: 9754, 9831, 9832, 9911, 10046, and 10047.

10046 (NP-17514, pp 47-62) RADIATION ONCOLOGY AND PATHOLOGY LABORATORY. Telles, N. C. (National Center for Radiological Health, Rockville, Md.).

Pathogenic mechanisms in radioinduced tumors were investigated. Light and electron microscope studies were made on hepatomas induced in rats by the synergistic action of x radiation and ethionine. Age sensitivity, dose rate effects, and hormonal effects on x-radioinduced thyroid tumors in rats were investigated. Effects of radiation on several oncogenic and non-oncogenic viruses in a line of diploid human cells were studied. A radiation-ethionine co-carcinogenesis study was conducted on liver tumors of rats. In long-term experiments tryptophan pyrrolase and total nitrogen content of the liver were examined in control and hydrocortisone injected rats that had previously been treated with various combinations of x radiation and ethionine. In short-term experiments the acute effects of x radiation and ethionine on tryptophan pyrrolase levels in control, hydrocortisone, and tryptophan treated animals were followed. (H.L.W.)

10047 (NP-17514, pp 99-106) COLLABORATIVE RADIOLOGICAL HEALTH LABORATORY. Garner, R. J. (National Center for Radiological Health, Rockville, Md.).

The purpose of the laboratory is to conduct a long-term study of the effects in the beagle of a single exposure to low levels of radiation with emphasis on investigation of the radiosensitivity of the unborn and young animal primarily in terms of long-term effects. The cesarian-derived, barrier-maintained beagle colony of 1700 animals provides the experimental material for the project. Using appropriate criteria according to age, LD_{50} values were estimated for ^{60}Co gamma radiation. Eye lesions following prenatal or neonatal irradiation included cataracts, retinal degeneration, and detached retinas. Behavioral studies were conducted on radiation effects on avoidance conditioning. Studies on the radiosensitivity of the hemopoietic system and effects of radiation on the fine structure of tissues were also conducted. In order to determine interrelationships between long-term effects of irradiation and the normal aging process, effects of age on blood chemistry, cardiovascular function, and skin composition were studied. Studies on acute injury following irradiation at various periods of development were integrated with the preliminary investigations required for designing long-term work. Effects

of γ radiation on the developing retina, cerebellar cortex, and hepatic enzymes were investigated. The Biometry Section maintains automated information on all dogs in the colony and provides assistance with data processing and analysis. (H.L.W.)

10048 (ORO–661) SEMIANNUAL PROGRESS REPORT ON AGRICULTURE, JULY 1–DECEMBER 31, 1967. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Aug. 1968. Contract AT(40-1)-Gen-242. 130p. Dep. CFSTI.

The status of research at the Agricultural Research Laboratory is reported for 13 areas of investigation. Separate abstracts are prepared on 12 of these areas. The other section of the report is a general statement concerning the health of the herds maintained for research purposes. A list of publications for the reporting period, and a list of staff members are also included. (E.R.B.)

For abstracts of individual sections see: 9836–9839, 9941, 10049–10054, and 10111.

10049 (ORO–661, pp 4-13) PRENATAL STUDIES. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

GAMMA RADIATION—effects on newborn cattle, rats, sheep, and swine following prenatal exposure, somatic cobalt-60
—effects on incidence of prenatal mortality in rats, effects of dose-rate on
—effects on incidence of eye abnormalities in weanling rats following prenatal exposure, effects of dose-rate on
—effects on development of testes in rats following prenatal exposure, effects of dose-rate on
—effects on development of sheep embryos and mortality of ewes, effects of dose-rate on whole-body (E.R.B.)

10050 (ORO–661, pp 14-15) EFFECTS OF PRENATAL IRRADIATION ON GROWTH. Martin, Polly G. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

Rats were γ-irradiated on the 18th day of gestation, and the effects on growth determined by measuring changes in the DNA, RNA, protein, and organ and whole-body weights at intervals up to 160 days of age. Damage induced at the time of irradiation either by cell death, increased cell-cycle time, or both was severe enough to cause permanent damage. (E.R.B.)

10051 (ORO–661, pp 19-28) REPRODUCTION [STUDIES]. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

The effects of localized irradiation on prepuberal mammalian testes were determined using bull calves. In this study, the testes of 50, 90, and 150 day old bulls were locally irradiated with ^{137}Cs γ rays to a dose of 0 to 600 (for 50 day old calves) or 1500 (for 90 and 150 day old calves) R and the number of gonocytes, type-A spermatogonia, and tubule cross sections sterile were determined at 60 days, nine months, and 26 months postirradiation. The results indicated that the older the calf at the time of irradiation, the higher the single dose required to sterilize the animal. It is unlikely though, that the fertility of either the pre- or postpuberal bull would be effected by a single, acute, sublethal exposure to ionizing radiation. The effects of whole-body exposure to ^{60}Co γ rays on fertility, mortality, and growth of progeny are being studied in life study herds of cattle. Following γ irradiation at 18 months of age, a difference was noted in mortality incidence between higher dose exposures and controls, but so far, no other significant differences have appeared in this seven to eight yr old herd. (E.R.B.)

10052 (ORO–661, pp 29-46) LATE EFFECTS. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

GAMMA RADIATION—effects on burros, late pathological whole-body cobalt-60, tantalum-182, or zirconium- niobium-95
—effects on burros and swine following exposure to mixed γ neutron bomb, late whole-body pathological
—effects on burro foals, late pathological whole-body cobalt-60
—effects on burros following exposure to mixed γ-neutron doses from reactor, late whole-body pathological
—effects on physiology and work performance of shetland ponies, late whole-body cobalt-60
—effects on mortality of swine, effects of very low dose-rate on whole-body cobalt-60
NEUTRONS—effects on burros and swine following exposure to mixed γ-neutron bomb, late pathological whole-body
—effects on burros following exposure to mixed γ-neutron doses from reactor, late pathological whole-body
RADIUM—toxicity in sheep, pathology report on
STRONTIUM-90—toxicity in sheep, pathology report on (E.R.B.)

10053 (ORO–661, pp 56-7) TISSUE CULTURE. McFee, A. F. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

Leucocytes from pigs were maintained in cell culture to determine the normal behavior of the leucocytes in culture. Reliable parameters were established, involving leucocyte number, cell viability, pH change, leucocyte type distribution, uptake of labeled DNA precursors, and increase in nuclear size, for use as indicators of radiation damage in cultured leucocytes. (E.R.B.)

10054 (ORO–661, pp 58-60) PATHOLOGY. Johnson, D. F. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

The results of pathological examinations of irradiated animals are reported. These include autopsy reports on cattle and swine that either died or were sacrificed following whole-body exposure (unilateral exposure only in one case) to γ or neutron radiation. In one case, multiple doses of oral and intravenous radioactive iodine and cerium had been administered in addition to whole-body γ irradiation and unilateral neutron irradiation. (E.R.B.)

10055 EFFECTS OF RADIATION ON THE ADRENAL CORTEX. IV. INVESTIGATIONS WITH RATS ON THE FIRST CORTICOSTEROID INCREASE FOLLOWING WHOLE-BODY RADIATION. Flemming, Kurt (Univ., Freiburg i. B.); Geierhaas, Bruno; Hemsing, Wolf; Mannigel, Ursula. Int. J. Radiat. Biol., 14: 93-105(1968). (In German).

The first corticosteroid increase in the adrenals and blood of whole-body x-irradiated rats was investigated. It was manifest from five min to six hrs following irradiation. The corticosteroid level was raised to maximum values five min post-irradiation; thereafter it decreased rapidly. At 12 hrs post-irradiation there was a slight increase independent of the circadian rhythm. Sham-irradiation also caused a short corticosteroid increase. In rats accustomed to the experimental conditions, the sham-irradiation effect was abolished but not the x-irradiation effect. In rats four to 32 wks old it was independent of age. It occurred in both sexes but was stronger in females than in males. Between 250 and 10,000 R it was dose-dependent. The reaction pattern resembled other stress-reactions; as far as that was concerned it was non-specific. The causal basic processes were specific. They might lead to the occurrence of pharmacologically active amines in tissue and blood. Such amines could stimulate the adrenocortical function via the central nervous system and hypophysis. (auth)

10056 EFFECTS OF FRACTIONATED X RADIATION ON THE HEAD PHASE OF THE EMBRYONIC DEVELOPMENT OF THE MOUSE. PART II. Konermann, Gerhard (Univ., Freiburg i. B.). Strahlentherapie, 136: 484-95(Oct. 1968). (In German).

Gravid mice of an inbred strain were irradiated during one or more periods of the embryonal development (blastogenesis, organogenesis and fetal growth period) with a daily fractionated dose of x rays at 5, 10, 20, 40, 60, 80, and 100 R/day. The effects were studied after uterine section at the completed 18th day of gestation period. It was observed that the type and the severity of the morphologic radiation damage depended more on the period of irradiation, i.e. the age of the embryo, than on the doses administered. The weight reduction of the foetus, however, corresponded more to the total dose. After even low doses during the blastogenetic phase, higher foetal weights were observed. From the different relations observed between dose, time of irradiation, foetal weight, and severity of the radiation damage it was concluded that limited restitutive processes would partly correct the radioinduced lesions. (auth)

10057 EFFECTS OF PATERNAL X-IRRADIATION OF LITTER SIZE AND EARLY POST-NATAL MORTALITY IN SWINE. Mullaney, Peter Daniel. Ames, Iowa, Iowa State Univ., 1968. 105p.

Thesis.

The genetic effects of paternal irradiation on the litter size and early postnatal mortality in swine were studied in 32,372 pigs in 3053 litters of Duroc and Hampshire breeds, raised at the Bilsland Memorial Farm, Madrid, Iowa, between spring 1959, and fall, 1966. The testes of normal sires were treated directly with a total dose of 300 R (at a rate of 100 R per min) of x rays approximately six months before the sires were mated. These sires comprised about half of the total number of sires used during the study. The other sires were used as controls. Four treatment combinations were possible, with the combinations of sire and maternal grandsire treatment of 0 R and 300 R of spermatogonial irradiation. Observations were corrected for the environmental effects of the year and season of birth of the litter, parity of the dam, and the regression of litter size on the particular trait. The effects of sire treatment, maternal grandsire treatment, and the interaction between sire treatment and maternal grandsire treatment on each trait were inconsistent between breeds and generally not significant. Traits showing significant effects ($P < 0.05$) were litter size and mortality. There was little evidence that irradiation treatment changed the variation of the traits studied. Sire and dam components of variance were small and generally not significant. The

heritability of each trait estimated from a combined hierarchal analysis of each sire treatment group were generally low; further estimates of heritability and estimates of repeatability and phenotypic and genetic correlations were calculated from daughter-dam regression analysis. (M.M.B.)

10058 PAPILLOMA INDUCTION WITH 9,10-DIMETHYL,1,2-BENZANTHRACENE FOLLOWING IRRADIATION OF THE SKIN PORTIONS. Turusov, V. S. (Inst. of Experimental and Clinical Oncology, Moscow). Vop. Onkol., 11: 58-62(1965). (In Russian).

The experiments included 5 groups of 50 $(C57 \times CBA)F_1$ mice in each, wt 25 to 30 g, males and females, 3 to 4 months old. A $^{144}Ce/^{144}Pr$ plaque served as a radiation source. The total dose was 250,000 erg/cm^2 at a dose rate of 360 erg/cm^2/sec. Conversion of the dose to various rad/depth values was explained. A selected area of dorsal skin (23 × 15 mm) was shielded with 3-mm thick Plexiglas and with a 2-mm thick lead plate. To measure the growth of hair, the fur was removed from an area larger than the irradiated portion. Irradiation was conducted 10 days after depilation, during the period of hair growth, or after 20 to 22 days, during the rest phase of hair growth. Then 45 days after irradiation, weekly application of a 0.0025% solution of 9,10-dimethyl,1,2-benzanthracene (DMBA) was begun. One drop was applied during the first 16 weeks and 2 drops from the 17th to 33rd week. A non-irradiated group of mice also underwent depilation and application of the carcinogen, beginning 2 months later. The results showed that preliminary skin irradiation in mice accelerated development of papillomas induced by prolonged subsequent application of DMBA. This acceleration of carcinogenesis was expressed by a significant shortening of the latent period for the appearance of tumors and in a much higher incidence of tumors among irradiated mice. The number of mice with papillomas was ~2 times higher in irradiated groups than in controls, 33 weeks after the beginning of treatment with DMBA. In preirradiated mice a frequent regression of papillomas was noted which was not observed in control mice. Irradiation in males at the rest period of the hair cycle was more effective in stimulation of papillomas development than irradiation during the period of hair growth. (BBB)

10059 EFFECTS OF SMALL DOSES OF RADIOACTIVE STRONTIUM ON THE RAT BONE MARROW. Stokke, T.; Oftedal, P.; Pappas, A. (Norwegian Radium Hospital, Oslo. Univ. of Oslo). Acta Radiol., Ther., Phys., Biol., 7: 321-9(Oct. 1968).

Bone marrow cellularity in the rat was measured after injection of small amounts of ^{90}Sr. Reduced cellularity could be observed 6 and 12 weeks after injection of 1.5×10^3 μCi/kg, leading to accumulated doses of 10 to 20 millirad β radiation. (auth)(TSS)

10060 VIABILITY OF STORED BONE MARROW COLONY FORMING UNITS. Carsten, A. L.; Bond, V. P. (Brookhaven National Lab., Upton, N. Y.). Nature (London), 219: 1082(Sept. 7, 1968).

The studies described were with reference to the use of bone marrow transplantation in disease states and after exposure to radiation. Evaluations were made of the viability of bone marrow CFU after suspension in two common suspending media at room and ice temperatures. Cells were injected into mice which had received a whole body exposure of 700 R of 250 kVp X-rays during an hour before injection; the mice were killed after 7 days and macroscopic spleen colonies were counted. It was found that ice temperature preserves viability better than room temperature. It was also found that viability is influenced by suspending medium, saline G maintaining the cells for longer than $CMRL_{1066}$, the most marked differences being at short time intervals (30 min.). This early effect suggests that there is a sub-population of cells which are immediately rendered non-viable in $CMRL_{1066}$ solution. A mouse strain dependence was also found. Close control of handling techniques is emphasized. (UK)

10061 EFFECTS OF RADIATION DAMAGE TO BONE MARROW ON SUSCEPTIBILITY OF CHICKS TO ERYTHROLEUKEMIA VIRUS. Chi, C. H.; Lagerloef, B. (Karolinska Institutet, Stockholm). Acta Radiol., Ther., Phys., Biol., 7: 353-63(Oct. 1968).

Groups of chicks were inoculated with erythroleukemia virus 4, 8, and 20 days after exposure to 600 rad ^{60}Co γ radiation. Biopsy material from the femur marrow was obtained immediately prior to the virus inoculation. The incidence of leukemia and the latent periods to death of the chicks were recorded and a comparison was made between the groups of irradiated plus virus-inoculated chicks and, respectively, only virus-inoculated chicks. The results support the view that the pathogenic effect of the virus can be modified by varying the number of target cells and their differentiation. (auth)

10062 INFLUENCE OF INFRARED-RAYS UPON THE HEMOGRAM OF X-IRRADIATED RABBITS. Nagata, Kohei (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho, 79: 1-50(May 1967). (In Japanese).

White male adult rabbits were x-irradiated at 100, 300, and 600 R and/or given infrared irradiation for 5, 15, and 30 min. The blood picture of rabbits was then examined. The effect of x irradiation on the number of red blood cells was relatively mild. There was no definite relation between the red blood cell count and the dose and the effect of infrared rays after x-ray irradiation was also unclear. The change in hemoglobin was not great. There was a mild decrease in number of blood platelets in the animals given 300 R and 600 R of x rays, while slightly greater decrease was observed in rabbits given 600 R of x rays. As to the correlative action of x ray and infrared rays, the latter proved to be effective in those given 100 R of x ray and 5 minutes of infrared rays, in those given 300 R of x ray and 5 or 15 minutes of infrared ray, and in those given 600 R of x ray and 5 or 15 minutes of infrared rays. The rate of decrease in blood platelet count was great in the animals given 30 minutes of infrared rays after x irradiation. The decrease in number of white cells ran with the dosage of x irradiation, and in the animals given 600 R, there was still a decrease of 50% after 21 days. Infrared rays given 5 or 15 minutes after irradiation of 300 R and those given for 15 minutes or 30 minutes after irradiation of 600 R proved more effective. The decrease in number of pseudoeosinophils following x irradiation ran parallel with the dosage of irradiation. This was especially remarkable in the animals given 600 R which still indicated a 40% decrease even after 21 days. As to the correlation between x irradiation and infrared rays, the decrease in number of pseudoeosinophils was less remarkable in those given infrared rays for 15 or 30 minutes after 600 R of x ray, and recovery took place rapidly. The decrease in number of lymphocytes occurred right after x irradiation, and the rate of decrease became greater with increase of dosage. In the animals given 100 R x irradiation, the rate of decrease in number of lymphocytes was lower in the group given infrared rays for 15 minutes as compared to the control, while this was greater in the group given infrared rays for 30 minutes. The rate of decrease in number of lymphocytes was milder than that in the control in the animals given infrared rays after irradiation of 300 R or 600 R of x ray, and recovery took place more rapidly. No definite correlation could be found in other white blood cells. (NSA of Japan) (TSS)

10063 RADIATION-INDUCED INVOLUTION OF THE LYMPHATIC ORGANS OF THE YOUNG CHICKEN. Montour, James L. (Medical Coll. of Virginia, Richmond. Oak Ridge National Lab., Tenn.). Acta Radiol., Ther., Phys., Biol., 7: 337-45(Oct. 1968).

Ten-day-old leghorn cockerels were exposed to 50 R, 100 R, 200 R, or 400 R of x radiation at either 8.8 R/min or 96.5 R/min. Determinations of the combined weights of the thymus, bursa of Fabricius, and spleen were made for the ensuing 5 days. Maximum depression of the weights of these organs was obtained 1 day after the low dose rate exposures and 2 days after the high dose rate exposures. Measured 5 days after exposure, the combined lymphatic organ weights were reduced 50% by 395 R when the dose rate was 96.5 R/min. (auth)

10064 HAIR AND IONIZING RADIATION. Van Caneghem, P. (Univ., Liege). J. Belge Radiol., 51: 253-61(1968). (In French).

The hair cycle and experimental methods of study are described and the principal modifications of rat hair under x ray influence are described: modifications of growing speed, dysplasia, temporary and permanent epilation, dephasing greying. The study of the epilatory action of x rays as a function of the growing phases of the hair allows establishment of variations of its radiosensitivity depending on the hair cycle. Furthermore it allows specification of certain modalities of hair growth. The sensitive tissue is different from temporary and permanent epilation, and it seems that the action level is different; at the hair bulb for temporary, and at the bulge for permanent epilation. Certain recent experimental studies back up this point of view. (auth) (TSS)

10065 EXPERIMENTAL STUDIES ON RADIATION STOMATITIS. Fuchihata, Hajime (Osaka Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1296-1307(Jan. 1968). (In Japanese).

Radiation stomatitis was studied with regard to dependence on radiation quality, the dose-time relationship, and differing time-spacing factors. Rabbits were used and macroscopic and microscopic changes were examined. Changes of oral mucosa (cheek and tongue) were examined on the 1st, 3rd, 5th, 7th, 11th, 14th, 21st, 28th, 42nd, and 56th day after a single exposure of 2500 rads with ^{60}Co γ rays. Two proposed gradings to classify the stomatitis are summarized in tables, according to the macroscopic and microscopic findings respectively. Mucositis subsided in a range of 14th to 21st day postirradiation. There appeared some signs of epithelium regeneration on the 7th day after irradiation, even in a severe case developing ulceration and/or thick crust. Degenerative atrophy with moderate fibrosis was still noted in the mucous gland of submucosa on the 56th day after irradiation. When ^{60}Co

γ ray or 18 MeV electron beam was used, 10–15% more dose was required than in cases of 200 kVp x rays. Some dependence on radiation quality could be concluded in the appearance of stomatitis. Dose-time relationship was examined in term of the appearance of radiation stomatitis. According to the grading proposed in this paper, an exponential curve was obtained. In cases irradiated on a schedule of 3 times a week, mucosal reaction appeared earlier than in cases of daily fractionation, where weekly dose remained unchanged. It was interesting, on the other hand, that in cases irradiated on a schedule of once weekly—periodical fractionation of massive dose—, or in the case of so-called split-course schedule, less mucosal reaction was noted than in cases irradiated on a daily or 3 times weekly schedule. (NSA of Japan) (TSS)

10066 RADIOSENSITIVITY OF INDIVIDUAL MOUSE AND THE POLAROGRAPHIC PROPERTIES OF ITS ORGANS IN C57BL/6j MICE. Ueno, Yori (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 119-26(Feb. 1967).

The relation between the polarographic properties of brain, thymus, spleen and liver of C57BL/6j mice and their radiosensitivity was studied. In polarography, the first and the second reactions of Brdicka's catalytic reaction correspond, respectively, to the SH-group bound on the protein molecule and the SH-group included in the non-protein compounds. Therefore, the ratio of the wave heights of the first and second reactions appears to be one of the reasonable indices for showing the radiosensitivity, with the ratio of protective site to SH-enzymes essential for the living body, i.e., target site. The relation between the maximum tolerable dose (total dose after the repeated whole body irradiation with 200 R twice a week till the death) and the mean survival times after the 800 R whole/body irradiation in the anaesthetized and unanaesthetized mice, on one hand, and the average ratio, on the other, is nearly linear in the log-log plotting, except in a few cases. It seems, therefore, that the high value of the ratio corresponds to the high radioresistance of mice. The fact that the mean survival time is shorter for anaesthetized mice than for the unanaesthetized ones, is in accord with the results of the ratio. When unaffected by anaesthetization, the average values of the ratio for the brain and liver are higher than those of the spleen and thymus. The former are believed to be more radioresistant than the latter, and so the differences in the average ratio values of four organs deserve consideration in connection with the relation of the radiosensitivity. (NSA of Japan)

10067 PREDICTION OF RADIOSENSITIVITY OF VARIOUS MOUSE STRAINS. Ueno, Yori (Kyoto Univ.); Pospisil, Milan. Nippon Taishitsugaku Zasshi, 30: 109-11(1967).

The possibility of predicting the radiosensitivity of individual mammals from the individuality of physiological state of the mammals has been reported. Based on the results, the extension of the authors' hypothesis concerning the prediction of radiosensitivity from the level of individual animals to the level of animal populations was investigated. In the experiment, CF#1, dd/yf, C57Bl/6, and CBA strain mice were used. It was assumed that the individuals with the same physiological state had the same radiosensitivity irrespective of their strains. The relation between the proportions of individuals predicted to be radioresistant and the LD50/30 values representing the radiosensitivities of these strains was studied. The coefficient of this relation was shown to be R = 0.97. From the result, it appears that the hypothesis concerning the prediction of radiosensitivities of individual animals could be extended from the level of individuals to the level of populations. (NSA of Japan)

10068 THE EFFECTS OF IONIZING RADIATION ON THE SPONTANEOUS AND EVOKED BRAIN ELECTRICAL ACTIVITY IN RABBITS. 2. THE EFFECTS OF X-RAYS ON THE HIPPOCAMPAL SPONTANEOUS ELECTRICAL ACTIVITY. Minamisawa, Takeru; Tsuchiya, Takehiko (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1243-9(Dec. 1967). (In Japanese).

The effects of x rays on the hippocampal spontaneous electrical activity as was analyzed at δ_2 (1 to 2 c/sec), δ_1 (2 to 4 c/sec), θ (4 to 8 c/sec), α (8 to 13 c/sec), β_1 (13 to 20 c/sec), β_2 (20 to 30 c/sec) and β_3 (30 to 60 c/sec) waves by means of frequency analyzer were studied in rabbits, which were subjected to 1,000 R whole-body irradiation. The potential of these waves except θ and β_3 decreased considerably immediately after irradiation, increased gradually in the next hour and then showed a tendency to return to control level. From the forth hour these began abruptly to decrease again, up to about the twenty-first hour with a little variation. And then these potentials increased again and at the twenty-third hour they showed a tendency to return to control level. The potential of θ wave decreased during the first hour after irradiation and this decreased value lasted with a little variation up to the twenty-third hour. From the above results, it is considered that the hippocampal spontaneous electrical activity decreased after whole body x irradiation. (NSA of Japan)

10069 ROLE OF THE THYMUS IN THYMECTOMIZED MICE. Watanabe, Tatsuro (Nagoya Univ., Japan). Nagoya J. Med. Sci., 30: 351-64(Dec. 1967). (In Japanese).

Thymectomy was done on the newborn mice less than 24 hours after birth, and the following results were obtained. So-called "wasting syndrome" was noted in 60% of thymectomized C_3H mice, and in 50% of thymectomized $C_{57}BL$ mice. A decrease in number of lymphocytes was recognized not only in the peripheral blood, but also in the lymphoid tissues of the thymectomized mice. Transplantation of mastocytoma was possible when thymectomy had been performed in advance, even among the mice of different histocompatibility. When Primol 355 TA vaccine was injected into extremities of the thymectomized mice and its booster was given subsequently, marked infiltration of the plasma cells was observed in the superficial lymph nodes and the spleen. No significant change in the serum proteins was recognized between the control group and the thymectomized mice. Agglutinin titer against TA vaccine in the thymectomized mice was almost equal to or even higher than that of the control group. No significant difference of the transplantability of mastocytoma was noted between the thymectomized mice and the mice pre-treated with thymectomy in association with the injection of Freund's adjuvant and Ta vaccine. Mastocytoma was transplanted into the mice thymectomized either surgically or by x ray irradiation. Transplantation of mastocytoma was impossible even in the mice pre-treated with thymectomy and selective x ray irradiation. (NSA of Japan)

10070 ELECTRON MICROSCOPIC STUDIES OF RADIATION-INDUCED LEUKEMIA IN MICE: VIRUS RELEASE FOLLOWING TOTAL-BODY X-RAY IRRADIATION. Gross, Ludwik; Feldman, Dorothy G. (Veterans Administration Hospital, Bronx, N. Y.). Cancer Res., 28: 1677-85(Sept. 1968).

Within a few days after total-body x irradiation, leukemia virus particles could be observed in several organs of irradiated C3Hf mice. This was observed not only after fractionated irradiation (5 × 150 R), but also after a single (250 R) total-body x irradiation. Electron microscopic examination of several organs from the irradiated mice, such as spleen, lymph nodes, and bone marrow, revealed the presence of virus particles budding from the cell membranes; mature and immature type-C particles were also present in the intercellular spaces. Leukemia virus particles were also consistently present in organs of eight C3Hf mice with radiation-induced leukemia. The distribution of virus particles in organs of mice with radiation-induced leukemia was similar to that observed in mice with spontaneous or virus-induced leukemia; however, the number of virus particles observed in organs of mice with radiation-induced leukemia was lower than that observed in mice with passage A (Gross) virus-induced leukemia. These observations contrasted sharply with results of electron microscopic examination of organs of nonirradiated, normal C3Hf mice, which revealed the presence of usually only a few isolated virus particles in the thymus and occasionally also in lymph nodes or in the bone marrow. (auth)

10071 STUDIES ON THE EFFECT OF X-RAY IRRADIATION ON THE PARTIALLY REMOVED LIVER OF RATS. Shirota, Yasuo (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho, 78: 1-31(Jan. 1967). (In Japanese).

In four groups of rats, the livers were irradiated at 500 R, 1,000 R, 1,500 R, and 2,000 R total dose given fractionally at 500 R/day. The next day, from 65% to 75% of their livers were removed and differences in body weight, the restoration of the remaining livers, and histological changes of the rats of control and experimental groups were followed for four months. Rats irradiated more than 1,500 R were given voluminous vitamin K_1 and Adona to study their protective effects. The decrease of the body weight was in proportion to the irradiation dose. After irradiation at 2,000 R, rats died within fourteen days. Some histological changes were observed in the liver cells of the irradiated rats in proportion to doses: disordered arrangement, cloudy swelling, and opacity of the liver cells; deep stain, dense atrophy, and disappearance of the nucleus, appearance of polynucleus cells; oppression of the sinusoid and Disse's space, fatty degeneration, vacuolar degeneration, and the fibrosis of the cells were the main changes. But these changes were all reversible. Voluminous vitamin K_1 before irradiation was very effective in reducing x irradiation damage. But if the rats were irradiated over 2,500 R they died. Voluminous Adona before irradiation was also effective, but less so than vitamin K_1. Though x-irradiation at 1,500 R total on the liver of the rats was upper-limit, it was possible to irradiate it to 2,000 R total dose by using the styptics. (NSA of Japan) (TSS)

10072 HISTOCHEMICAL CHANGES IN ENZYMES OF THE CITRIC ACID CYCLE AND THE SUCCINOXIDASE SYSTEM IN VARIOUS ORGANS OF THE RAT FOLLOWING WHOLE-BODY IRRADIATION. Schmidt, Karl-Juergen; Walther, Gotfried; Ladner, Hans-Adolf (Univ., Mainz). Strahlentherapie, 136: 365-74(Sept. 1968). (In German).

With histochemical techniques, the content of isocitric, succinic, and malic dehydrogenases was determined in the liver, kidneys, heart, muscles, and brain in rats, 24, 48, and 72 hrs after whole body x irradiation at 650 R or 1950 R. An elevation of the enzymatic activity was observed when compared to controls; 48 and 72 hrs after irradiation, a dose dependent fall of the enzymes was observed. The cytochromoxydases reacted in the different body organs in a different manner. Review of these results and other reports in the literature emphasized the need for more systematic time studies of the activity of different enzymes in mammals after whole- or partial-body irradiation. Furthermore the significance of the relation between dose and enzymatic activity is emphasized. (auth)

10073 OBSERVATIONS ON THE METABOLISM OF GLUCOSE-6-PHOSPHATE-DEHYDROGENASE IN RAT ERYTHROCYTES FOLLOWING WHOLE-BODY IRRADIATION. Walther, G.; Schmidt, K.-J. (Johannes-Gutenberg Univ., Mainz). Radiol. Clin. Biol., 37: 156-61(1968). (In German).

Whole-body x irradiation (650 and 1950 rad) of rats caused a statistically significant increase of the G-6-PDH-activity of the erythrocytes. A maximum value of 157 mU/10^9 erythrocytes was measured. In some cases a diminution of the activity could be observed, that was particularly noticeable on the first day after 650 rad. The significance of this modification of activity is discussed. (auth)

10074 EFFECT OF NITROGEN MUSTARD ON THE HAEMOPOIETIC STEM CELLS OF THE BONE MARROW IN THE RAT. Harriss, E. B.; Aponte, L. (EURATOM, Freiburg i. B. Medizinisch-Naturwissenschaftlichen Hochschule, Ulm, Ger.). Cell Tissue Kinet., 1: 289-98(Oct. 1968).

The sensitivity of hemopoietic stem cells to the action of nitrogen mustard was investigated by transfusion of bone marrow from treated donor rats to recipients whose own hemopoiesis was reduced to low levels by whole-body x irradiation. By measurement of the resultant erythropoiesis in the recipients with radioactive iron, a comparison of the repopulating ability of nitrogen mustard treated bone marrow with that of normal bone marrow could be made. It was found that although a dose of 0.9 mg/kg body weight reduced bone marrow cellularity to less than 10% of normal, repopulating ability was not decreased to much less than half the normal level. This is in contrast to the effects of x radiation, which has a more marked effect on the stem cell population than on the differentiated marrow cells. Possible reasons for this difference are discussed. It could be that the proliferative or metabolic state of the cell plays a role, or that some repair mechanism is operative in the stem cells that does not exist in the differentiated cells. (auth)

10075 PECULIARITIES OF DEVELOPMENT OF TISSUE CULTURE OBTAINED FROM IRRADIATED CHICK EMBRYO. Kamalyan, L. A. Vop. Radiobiol., Sb. Tr., 5: 323-6(1965). (In Russian).

Examination of tissue culture obtained from cells of skin-muscular tissue of x irradiated chick embryos is described. Mitotic activity and viability of the cells obtained from irradiated embryos proved to be lower compared to those of the cells taken from non-irradiated ones. (auth)

10076 EXPERIMENTAL STUDY OF PRELIMINARY X IRRADIATION EFFECT ON COURSE OF ALLOXAN DIABETES. Manukyan, M. A. Vop. Radiobiol., Sb. Tr., 5: 309-15(1965). (In Russian).

Diabetes in 150 rats was caused by subcutaneous injection of 2.5 to 5% freshly prepared aqueous solution of alloxan, 125 to 150 mg/kg of body weight. A RUM apparatus was used for a total irradiation (500 R). The results obtained show that preliminary x ray irradiation (500 R) reduces animal's resistance to a diabetogenic dose of alloxan. A combined effect of alloxan and ionizing radiation in most cases aggravates the course of alloxan lesion of the pancreas. In latent and the most severe periods of acute radiation sickness the diabetes assumes an acute form with pronounced general toxic phenomena progressing anemia, and high lethality. In irradiated animals suffering from alloxan diabetes, the clinical features of radiation sickness are more evident and lethal outcome due to radiation sickness takes place earlier than in the controls (irradiated only). (auth)

10077 EFFECT OF INSULIN UPON COURSE AND OUTCOME OF ALLOXAN DIABETES IN IRRADIATED ANIMALS. Manukyan, M. A. Vop. Radiobiol., Sb. Tr., 5: 303-8(1965). (In Russian).

The experiments on 190 white rats are described. A RUM apparatus was used for a total single irradiation (500 R). Diabetes in rats was caused by subcutaneous injection of 2.5 to 5% aqueous solution of alloxan, 125 to 150 mg/kg of body weight. Insulin was administered in a dose of 1.2 unit during 12 days. The results obtained showed that administration of insulin in the case of alloxan diabetes, complicated by radiation sickness, influenced favorably the course and outcome of the disease. The lifetime of the rats treated with insulin was longer and the symptoms of diabetes were less pronounced. Insulin administration in the case of diabetes developed in the initial period of severe radiation sickness, brought about almost the same decrease of sugar level in the blood as is observed in the case of diabetes in non-irradiated animals. (auth)

10078 CHANGES OF ABSORBING CAPACITY OF RETICULO-ENDOTHELIAL SYSTEM AFTER BLOOD LOSS IN ANIMALS SUFFERING FROM SEVERE RADIATION SICKNESS OF MODERATE AND MILD DEGREES. Magakyan, A. G. Vop. Radiobiol., Sb. Tr., 5: 285-90(1965). (In Russian).

Examination of absorbing capacity of reticulo-endothelial system in rabbits is described. The experiments are carried out on 47 rabbits divided into 3 main groups: controls to irradiation (400 and 800 R), controls to bloodletting (30% of the whole circulating blood volume) and the experimental group in which irradiation (in similar doses) is combined with bloodletting. The results obtained show that irradiation (800 R) depresses absorbing capacity of RES. Bloodletting combined with irradiation (800 R) depresses the above capacity even more. Irradiation with a dose of 400 R stimulates the RES functions. Bloodletting is found to be a similar stimulating agent. The combination of the two factors stimulating the RES functions does not lead to summation of their effect but reveals a comparatively low degree of their activation. (auth)

10079 DISTURBANCE IN REGULATION OF STOMACH SECRETORY FUNCTION DUE TO X IRRADIATION AND BLOOD LOSS. Mikaelyan, M. G. Vop. Radiobiol., Sb. Tr., 5: 273-80 (1965). (In Russian).

Experimental data showed that in the case of a combined lesion of the body, the disturbance in regulation of the stomach gland secretory functions is more pronounced both in complex-reflex and in neuro-humoral phases of secretory period than in condition of irradiation or bloodletting alone. (auth)

10080 ON PECULIARITIES OF DEVELOPMENT OF F. DURAN-REYNALS PHENOMENON IN IRRADIATED RABBITS. Airapetyan, F. O. Vop. Radiobiol., Sb. Tr., 5: 223-7(1965). (In Russian).

It is found that in rabbits, x irradiated with a dose of 800 R, due to changes taking place in the hyaluronic acid of the skin, the phenomenom of F. Duran-Reynals develops rather specifically: during 1 to 3 days after irradiation the permeability of the animal's skin increases, during 8 to 9 days it becomes normal, 3 to 4 weeks after the onset of the disease the skin permeability abruptly falls but, starting from the 30th day after irradiation, it becomes normal again. (auth)

10081 SOME PECULIARITIES OF DEVELOPMENT OF RADIATION BACTEREMIA IN GUINEA PIGS AND WHITE MICE. Ter-Pogosyan, R. A.; Alaverdyan, M. I.; Ter-Avetisyan, A. T. Vop. Radiobiol., Sb. Tr., 5: 215-22(1965). (In Russian).

Chronic experiments show that dynamics of microbic invasion in irradiated guinea pigs and white mice depends on the magnitude of irradiation dose and the stage of radiation sickness. Experiments on white mice indicate that because of irradiation, the automicroflora seeding of their viscera develops more intensively (positive microbe findings are reported to be 38% in the liver and 35% in the spleen) than bacteremia. It is also found that bacteremia in irradiated guinea pigs takes a more severe course than in mice. (auth)

10082 EFFECT OF DIRECT CURRENT ON OXYGEN CONSUMPTION BY IRRADIATED RATS. Vlasenko, S. P.; Arutyunyan, P. K.; Shakhnazaryan, E. L. Vop. Radiobiol., Sb. Tr., 5: 177-82 (1965). (In Russian).

Experiments on 50 white rats are reported to have been carried out to study oxygen consumption (in ml per 100 gr of body weight) before and after irradiation, accompanied by anodic and cathodic galvanization of the rat's brain. Along with the experimental group the corresponding controls are described, used to examine the effect of anodization and cathodization of the animal's brain irradiated with a dose of 800 R. The experiments show that a single anodic and cathodic galvanization of the brain leads to a steady increase of oxygen consumption by intact rats while total x irradiation greatly reduces it. Anodization of the brain during irradiation removes the depressing effect of x irradiation. Anodization of the

brain during irradiation removes the depressing effect of x rays on oxygen consumption. (auth)

10083 EFFECT OF X IRRADIATION ON FUNCTIONAL ACTIVITY OF WHITE RATS TESTICLES. Vlasenko, S. P.; Alaverdyan, M. I.; Grigoryan, D. G.; Khachkavanktsyan, A. S. Vop. Radiobiol., Sb. Tr., 5: 149-53(1965). (In Russian).

Examination of x irradiation effects on spermatogenic function of the testicles and on their hyaluronidase activity reveals that total irradiation of rats with doses of 600 and 3000 R leads to decrease of above data seven days after irradiation. In the case of local irradiation of the testicles (with the same doses) the decrease of hyaluronidase activity and of the number of mature sexual cells is less pronounced. (auth)

10084 CHANGE OF BLOOD ALKALINE RESERVE AND OF AMOUNT OF TITRATION ALKALINITY OF URINE IN RABBITS DUE TO COMBINED EFFECT OF IONIZING RADIATION AND BLOODLETTING. Movsesyan, M. A. Vop. Radiobiol., Sb. Tr., 5: 141-8(1965). (In Russian).

In irradiated animals after bloodletting the rate of decrease of alkaline reserve and its further normalization depend both on irradiation dose and on the period of time after irradiation, during which bloodletting is carried out. In conditions of 800 R irradiation the most pronounced decrease of alkaline reserve and its latest normalization are observed in that group of animals in which bloodletting is carried out 2 to 2.5 months after irradiation, while in the rabbits in which bloodletting takes place 20 to 30 minutes after irradiation the above decrease is the least. In the latter case the irradiation seemed to prevent alkaline reserve from decreasing. The greatest and longest decrease of alkaline reserve is noted in the case of irradiation (1000 R) combined with bloodletting. In this group of rabbits preliminary irradiation, on the contrary, leads to decrease of alkaline reserve apparently due to increase of titration alkalinity in the urine which fact may also be of considerable importance. (auth)

10085 QUANTITATIVE AND MORPHOLOGICAL CHANGES OF THROMBOCYTES IN THE CASE OF SEVERE RADIATION LESION. Batikyan, I. G. Vop. Radiobiol., Sb. Tr., 5: 127-35 (1965). (In Russian).

Quantitative and morphological changes of thrombocytes as well as measurements of the platelet area in the case of severe radiation lesion in rabbits are discussed. Shortly after irradiation morphological changes are revealed by the increasing number of young and degenerative forms with a reduced number of mature ones. At the final stages of the experiment the number of old and irritation forms goes up. On the first day after irradiation the number of microthrombocytes increases while on the 10 to 15th days of irradiation the number of gigantic irritation cells whose size reaches 15 to 17 μ increases. (auth)

10086 DEPENDENCE OF FUNCTIONAL ACTIVITY OF LEUKOCYTES UPON THEIR GLYCOGEN LEVEL IN NORMAL AND IRRADIATED GUINEA-PIGS. Kheifets, Yu. B. Vop. Radiobiol., Sb. Tr., 5: 119-25(1965). (In Russian).

Irradiation of guinea-pigs with x rays (600 R) decreases phagocytic activity of leukocytes and their glycogen level shortly after irradiation (1, 3, and 6 hours). At this time the peripheral blood cells are, on the whole, functionally defective. Granulocytes, containing a great amount of glycogen and revealing a higher phagocytic activity, appearing in the blood six hours after irradiation, characterize a protective response of the body. (auth)

10087 INFLUENCE OF X-RAYS AND LIDAZE FERMENT ON DEVELOPMENT OF RADIATION BACTERIAEMIA IN WHITE MICE. Ter-Avetisyan, A. T. Vop. Radiobiol., Sb. Tr., 5: 95-9 (1965). (In Russian).

The experimental data reveal the effect of the hyaluronidase-hyaluronic acid biological system on genesis of radiation sickness. It is shown, in particular, that a combined action of x ray and lidaze ferment brings about the intensification of postirradiation bacteremia, the loss of weight by experimental animals (white mice) and the reduction of leukocyte count. All these phenomena disappear or become normalized by the 30th day of radiation sickness. (auth)

10088 SOME CHANGES IN THE LIVER OF IRRADIATED MICE. Ogandzhanyan, E. E.; Manvelyan, K. R. Vop. Radiobiol., Sb. Tr., 5: 63-8(1965). (In Russian).

The purpose of the investigation is to study changes occurring in the liver of black mice due to a single total irradiation (600 R). The experimental data indicate that considerable morphohistochemical changes are observed in the liver parenchyma on the first days after irradiation. As radiation sickness progresses, a sharp decrease of the RNA level takes place, and although, starting from the 8th day the RNA level in the liver cells gradually increases, it does not reach its normal concentration even on the 28th day of radiation sickness. From the 14th day some foci of myeloid hemopoiesis are observed and on the 17th day there appear large cells with gigantic nuclei. (auth)

10089 JOINT EFFECT OF X IRRADIATION AND BLOODLETTING ON RADIATION BACTERIAEMIA IN RABBITS. Papoyan, S. A.; Movsesyan, M. A.; Ter-Pogosyan, R. A.; Alaverdyan, M. I.; Ter-Avetisyan, A. T.; Magakyan, A. G. Vop. Radiobiol., Sb. Tr., 5: 19-28(1965). (In Russian).

It is shown that in x-ray irradiated rabbits bacteremia may be observed as early as the first day of the post-irradiation period. The microbe release occurs during 3 to 4 weeks of radiation sickness. Joint effect of x rays and severe blood loss on rabbits is accompanied by a much more rapid and intensified process of autoinfection than in the case of irradiation alone. Severe loss of blood appears to decrease the body resistance to irradiation, resulting in rather sharp changes in the condition of experimental animals. (auth)

10090 VOPROSY RADIOBIOLOGII. SBORNIK TRUDOV. TOM V. (Problems of Radiobiology. Collection of Reports. Volume V). Voprosy Radiobiologii, Sbornik Trudov (Armenian S.S.R.), Tom V. Erevan, Izdatel'stvo AN Arm. SSR, 1965. 346p.

Forty-one articles are collected in this book. Separate abstracts were prepared for 37 of these. (C.O.)

For abstracts of individual chapters see: 9865–9872, 9877–9879, 10013–10021, 10075–10089, 10125, and 10126.

10091 THE ROLE OF L-FORMS IN THE PATHOGENESIS OF LISTERIA MONOCYTOGENES INFECTIONS. Brem, Antonina Martha. Ann Arbor, Mich., Univ. of Michigan, 1968. 112p. Thesis.

The transformation of stock cultures and recent isolates of all the serotypes of Listeria monocytogenes from the bacillary structure to the L-form was demonstrated. This transition was also induced by fresh sera from mice and rabbits, and by glycine, lysozyme, fresh normal tissue, or penicillin G. Morphologically, the L-forms were similar to those observed in other bacterial species. The L-forms were easily induced, readily propagated, and varied in stability according to serotype. Type 4b, the most prevalent serotype in human listeriosis, was the easiest to transform and reverted most readily to the parent bacilli. The morphological and biochemical characteristics of revertants were identical to those of the parent bacilli. L-forms of L. monocytogenes were isolated from the heart, kidney, liver, and spleen tissues of mice three months after they were infected with a sublethal inoculum of type 1 or type 4b L. monocytogenes. L-forms were observed in tissue when a fluorescent antibody technique was employed. The L-forms of type 1 and type 4b L. monocytogenes did not elicit macroscopic pathological process in Swiss Webster, C_3H, and C_{57} mice of various ages when administered intracerebrally, intranasally, intraperitoneally, intravenously, or subcutaneously. Attempts to educe overt disease in mice infected with L-forms through lowering their resistance by chilling, injection of Brucella abortus endotoxin, exhaustion, cortisone treatment, pregnancy, starvation or x-irradiation were unsuccessful. Mice infected with L-forms prior to or during pregnancy bore average size litters, and L-forms could be isolated from the tissues of the offspring. The L-forms could be isolated from some organs of all of the mice one month after infection and from 80% of the mice after six weeks. They were most readily isolated from the liver. Observations made during these studies suggested that infection with the L-form did not protect mice against infection with bacillary L. monocytogenes. It was suggested that L-forms of L. monocytogenes in themselves might not be pathogenic; however, they might allow persistence of the bacterium in the host. That the organism might revert to the pathogenic bacillary form when the individual was properly stimulated was not proved. (Disser. Abstr.)

10092 COMPARATIVE PHYSIOLOGY OF L-M CELLS PROPAGATED IN VITRO AND IN FEMALE AND MALE MICE. Hellman, K. B.; Hellman, A.; Cumming, R. B.; Novelli, G. David (Oak Ridge National Lab., Tenn.). J. Nat. Cancer Inst., 41: 653-64(Sept. 1968).

Mouse L-M cells propagated in vitro produced fibrosarcomas when inoculated into intact, untreated female and male C3H/Anf mice. Whole-body x irradiation of the intact animals before inoculation increased the incidence of tumor development in both sexes. Definitive results were obtained between 56 and 63 days from the time of injection of cells. Males exhibited a consistently greater percentage of regressed tumors than females. Chromosomal analysis and determinations of nucleoside incorporation of L-M tumor cells demonstrated sex-dependent differences ex-

pressed by cells grown in female and male hosts. Results suggest that the female host offers a more favorable environment for the propagation of L-M cells in vivo. The influence of progesterone indicated that the cell system is not entirely controlled by the hormone, but that the hormone may influence either directly or indirectly depression of the immune response. Observations made of the increased growth of tumors in pregnant females suggest that other hormones and the age ramification of the animals used to determine the rate and extent of tumor growth may also be involved. The possible role of hormones and the immunological capacity of the animal are discussed relevant to the effect of L-M growth in female and male hosts. (auth)

10093 EFFECT OF ULTRAVIOLET IRRADIATION ON CHANGE OF ERYTHROCYTE SIZE. Gilyarova, V. N.; Frank, G. M. pp 262-7 of Voprosy Biofiziki, Biokhimii i Patologii Eritrotsitov. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

The effect of uv irradiation on erythrocyte size was studied in 60-day-old chickens. Before uv irradiation, hemoglobin level, erythrocyte count, erythrocyte distribution by area in blood smears, and body weight were determined. On the 63rd day, the experimental animals were uv irradiated with a 50 MED·hr/m dose for 10 days, followed by a 10-day interval, and then a second 10-day period of irradiation. Control and experimental animals were examined at the ages of 60, 72, 82, 94, and 104 days. Findings for experimental animals showed a weight gain of 20.2%, a hemoglobin level increase of 3%, and an erythrocyte count increase of 5.6%; control animals displayed a body weight loss of 1.2%, a hemoglobin level increase of 4%, and an erythrocyte count decrease of 0.03%. Erythrocyte size of experimental animals was increased by 30% compared to control animals. It is interesting to note that when 110-day-old chickens were given vitamin D in their daily ration for 20 days, body weight increased by 9.4%, hemoglobin level was reduced by 3.2%, and erythrocyte count increased by 2.3%. With the addition of vitamin D to the diet of the experimental animals, body weight was further increased by 2.7%, hemoglobin level was reduced by 1% compared to initial data, and the erythrocyte count increased by 0.6%. Erythrocyte size of control animals, following the inclusion of vitamin D in the diet, did not undergo any changes, but erythrocyte size of experimental animals tended to become normal. Change of erythrocyte size appeared to be an RBE index for uv irradiation. Erythrocyte size changes induced by uv irradiation was related to the complex nature of its indirect effect on hematopoiesis and on physicochemical processes. The action mechanism of vitamin D was not clear. (auth)

10094 EFFECTS OF X-IRRADIATION ON THE CEREBRAL CORTEX OF THE MONKEY. Caveness, William F.; Roizin, Leon; Carsten, Arland; Schade, J. P. Trans. Amer. Neurol. Ass., 92: 188-93(1967). (BNL-12930).

Twenty-four animals were exposed to a single dose of 3500 rads of x rays. The area of irradiation was limited to the right visual cortex of the occipital lobe. Serial electroencephalographic and clinical examinations were performed prior to and at regular intervals after irradiation. Some of the animals were sacrificed for microscopic evaluation of changes in the irradiated right visual cortex and the non-irradiated left visual cortex. The responses of the visual cortex to photic stimulation consisted of a decrease in amplitude of the responses from the irradiated side when compared with those from the non-irradiated side. Between 18 and 22 weeks high amplitude slow waves appeared in the electroencephalogram in many of the animals. Animals that were sacrificed showed depilation and changes in the scalp over the irradiated area. Routine microscopic examinations revealed moderate astrocytic hyperplasia and microglial hypertrophy and hyperplasia in the irradiated cortex of two of the monkeys. Quantitative evaluation of electronmicrographs showed a significant reduction in volume of neurons and an increase in glial elements. (H.L.W.)

10095 FLEAS OF THE NATIONAL REACTOR TESTING STATION. Allred, Dorald M. (Brigham Young Univ., Provo, Utah). Great Basin Natur., 28: No. 2, 73-87(June 29, 1968).

Fleas of 38 species were collected from mammals of 21 species and one species of bird between June 1966 and September 1967 at the National Reactor Testing Station in Idaho. Almost two-thirds of the species collected represent new records for Idaho, and over 40 collections represent new host records. Twenty-one of the species are of medical importance in plague transmission as demonstrated by findings in nature or experiments in the laboratory (Stark, 1958). Fourteen of these important species have a limited geographic distribution at the station, five are moderately distributed, and two demonstrate a wide-spread distribution. The greatest number of species was taken in August. Most species showed little if any difference relative to sex relationship and degree of host infestation. The number of species of fleas infesting a particular host was not directly proportional to the numbers of hosts examined in all cases. Frequencies of simultaneous occurrence of fleas of two different species on the same host were indicative that species competition may occur in some instances. There was no apparent correlation between the number of species of fleas and a predominant plant type in any area, although variations in numbers did occur between different study areas. The geographic distribution of fleas at the station was related to the geographic range and variety of their hosts. Species of fleas infesting the greatest variety of hosts were Monopsyllus wagneri, Meringis parkeri, and Meringis hubbardi. Mammals infested by the greatest variety of fleas were Peromyscus maniculatus, Neotoma cinerea, Dipodomys ordii, Onychomys leucogaster, Eutamias minimus, Spermophilus townsendii, and Microtus montanus. Comparative rates of infestation between an irradiated area and a non-irradiated control area showed that twice as many animals were infested in the control area as in the irradiated plot. (auth)

10096 ANAPLASMA MARGINALE-INFECTIVITY IN SPLENECTOMIZED AND RADIATED RABBITS. Belli, Luigi Brutus. College Station, Tex., Texas A and M Univ., 1968. 75p.

Thesis.

The possibility of A. marginale infection was studied in rabbits. To alter their receptivity, intact and splenectomized rabbits were subjected to different amounts of ^{60}Co γ radiation. The inoculum consisted of anaplasma infected bovine whole blood, freshly drawn, containing intact erythrocytes. There was no A. marginale development detectable by laboratory means either in intact irradiated rabbits, in splenectomized, or in splenectomized and irradiated rabbits. A single intravenous injection of virulent A. marginale in these rabbits did not elicit a detectable CF antibody response. These results excluded that an antigenic response had taken place even as a result of an inapparent A. marginale multiplication in the rabbits. There was no A. marginale infectivity, biologically demonstrable, in the blood of splenectomized and irradiated rabbits after 10, 20, 40, or 60 days. When this rabbit blood was injected into splenectomized susceptible calves it did not reproduce the disease. None of the calves inoculated with rabbit blood showed a detectable CF antibodies response. When these calves were challenged with anaplasma carrier blood all died of acute anaplasmosis. This excluded the hypothesis that rabbits were asymptomatic carriers. This also proved that the blood of anaplasma injected rabbits was neither pathogenic, antigenic, nor had any premunizing properties for susceptible calves within the 60 days period tested. If there were an A. marginale infection taking place in the rabbits, after a period of adaptation and multiplication of the etiologic agent, the incubation period would have been beyond the 60 days tested. The survival of A. marginale injected into rabbits was biologically detected by time lapse sub-inoculations into splenectomized calves. The calves sub-inoculated within 24 hr had a shorter incubation period than those sub-inoculated at 48 hr. This was probably due to a numerical progressive reduction of the etiologic agent. All calves inoculated within 48 hr had an acute lethal anaplasmosis. These results led to the conclusion that within this period A. marginale did not undergo any detectable change in virulence while exposed in vivo to the rabbit tissue enzymes. However calves sub-inoculated at 120, 240, and 480 hrs remained negative and when challenged proved to be fully susceptible. It was concluded that rabbits did not allow a detectable multiplication of the A. marginale organism in their blood nor underwent a negative phase and were not asymptomatic carriers of the disease. A marginale survived in rabbits without a detectable change in virulence for more than 48 hrs and less than 120 hrs. (Diss. Abstr.)

Man

Refer also to abstracts 9853, 9889, 9937, 9958, 9965, 9991, 10006, 10011, 10035, 10043, and 10044.

10097 (ANL-7461) HEALTH DIVISION GAMMA-RAY SPECTROSCOPY GROUP RESEARCH REPORT, JULY 1965-JUNE 1968. (Argonne National Lab., Ill.). July 1968. Contract W-31-109-eng-38. 102p. Dep. CFSTI.

The incidence of radium-induced malignant tumors and blood dyscrasias was related to current or preterminal radium burden measurements and to retrospective estimates of maximum radium burdens for a series of 293 persons, most of whom acquired radium burdens in the period 1918 to 1933. The 46 malignant diseases included 23 bone sarcomas, 16 neoplasms of the skull (principally mastoid and paranasal air cell carcinomas), and 7 leukemias and aplastic anemias. Retrospective estimates of maximum radium burdens were made by application of the appropriate power function for ingestion or for multiple injections. The power function parameters used here ($a = 0.30$ and $b = -0.44$) were recently derived by an analysis of data from long-term studies on 8 patients for whom suitable data are available. The lowest estimated maximum radium burden for the bone sarcoma

cases was 6.72 μCi, and that for carcinoma of the maxilla was 1.23 μCi. The comparable value for radium-attributed leukemias and other blood dyscrasias was over 50 μCi. Based on the estimated maximum initial burden, these data imply at least a twelvefold margin of safety in the maximum permissible level for internally deposited radium. (auth)

10098 (NYO-2181-5(Vol.2)) EPIDEMIOLOGICAL FOLLOW-UP OF THE NEW JERSEY RADIUM CASES. Final Report, November 1957–June 1967. (New Jersey State Dept. of Health, West Orange. Radium Research Project). July 1968. Contract AT(30-1)-2181. 486p. Dep. CFSTI.

Case histories are summarized for over 500 individuals who were employed as dial painters and used luminous paints containing either ^{226}Ra or ^{228}Ra or both. Most of the radiation exposures occurred more than 45 yrs ago. (C.H.)

10099 TECHNIQUE FOR THE DETERMINATION OF BINUCLEATED LYMPHOCYTES IN PERSONS EXPOSED TO LOW X-RAY DOSES. Farkas, F.; Racoveanu, N.; Lupescu, H. Oncol. Radiol., 6: 425-30(1967). (In Rumanian).

A modified technique for the binucleated lymphocyte count was described, it being considered as a specific test of low x-ray exposures. This technique differed from the previous ones in that it used the lymphocyte concentrate according to the procedure described by Rabinowitz, and it recorded the elements counted by an electronic device that curtailed the duration of the test. Since its duration was significantly reduced by the changes made, the test could be employed in examining a large number of people subjected to x-ray exposures. The results and the classification of lymphocyte nucleus anomalies commonly encountered in individuals exposed to radiations was stated. (auth)(Rom. Sci. Abstr.)

10100 BIOLOGICAL EFFECT OF BREMSSTRAHLUNG OF HIGH ENERGY IN RADIUM THERAPY. Shantyr, V. I. (Kharkov Scientific-Research Inst. of Medical Radiology). Med. Radiol., 13: No. 11, 54-8(Nov. 1968). (In Russian).

The results of investigations of the biological effect of γ radiation (linear accelerator, 3.5 MeV) depending upon the exposition, absorbed dose, dose rate, and effective energy of the ray-spectrum are reported. There was a definite relation between the biological effect and the dose of radiation. (auth)

10101 DIAGNOSTIC IRRADIATION, CONGENITAL MALFORMATIONS AND SPONTANEOUS ABORTION. Kinlen, L. J.; Acheson, E. E. (Oxford Univ.). Brit. J. Radiol., 41: 648-54 (Sept. 1968).

The irradiation received in the first trimester of pregnancy or at any time before pregnancy by 379 women admitted to hospital with spontaneous abortions, and 605 women delivered of babies with congenital malformations was compared with that received by a control group. A comparison was also made of the irradiation received by 392 fathers of malformed babies and a control group. No significant difference was found between case and control groups in the number of persons whose abdomens were x-rayed. However, the number of such radiographs was small, and during the first trimester of pregnancy only two cases of abdominal radiographs were found, both in the third month. There was thus no evidence that diagnostic irradiation played an important part in the etiology of abortions requiring hospital admission or of congenital malformations. The effect of diagnostic irradiation in influencing either of these conditions would not, however, be determined in a sample of this size. Interesting differences were demonstrated in the frequency of X-ray examinations of various sites between the sexes and between Britain and the United States. (auth)

10102 ON THE PROBABILITY OF RADIATION BEING THE CAUSE OF LEUKEMIA. Oftedal, Per (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway); Magnus, Knut; Hvinden, Torleif Brit. J. Radiol., 41: 711-12(Sept. 1968).

A statistical theorem known as Baye's Law was applied to calculate the probability of radiation being the cause of granulocytic leukemia in a 37-year-old man who had suffered accidental radiation exposure of about 10 rem bone marrow dose seven years earlier. The probability that radiation was the cause was three times higher than the probability of spontaneous origin. (F.M.M.)

10103 THORIUM BODY BURDENS IN HUMANS FOLLOWING THOROTRAST MYELOGRAPHY AND THE INCIDENCE OF MYELOPATHY. McNeill, K. G.; Harrison, Joan E.; Mirza, K. F.; Tai-Pow, J.; Geale, D. C.; Barnett, H. J. M. (Univ. of Toronto. Radiation Protection Lab., Toronto). Brit. J. Radiol., 41: 755-61(Oct. 1968).

Toronto General Hospital records show that 26 persons received Thorotrast myelography in the years 1940 and 1941. Of these, 15 have been located and the activity in nine has been measured for residual thorium activity using a whole-body counter and thoron exhalation techniques. For comparison, measurements of thorium burdens of nine subjects who had Thorotrast arteriograms are presented. Of the 15 myelography cases located, 12 have had serious progressive cauda equina deficit. Even on the assumption that the 11 unlocated are all well, the incidence of myelopathy is still nearly 50 per cent. On certain assumptions the thorium burdens of the nine measured are ascertained to be between 0.03 and 1.0 g, with a mean value of 0.5 g. It is pointed out that these levels are all comparable to, and in some cases less than, the maximum permissible body burdens (ICRP) and yet severe effects have occurred. (auth)

10104 ANOMALIES OF THE EYES IN DESCENDANTS OF WOMEN, IRRADIATED WITH SMALL X-RAY DOSES DURING AGE OF FERTILITY. Jacobsen, L.; Mellemgaard, Lis (State Hospital, Copenhagen). Acta Ophthalmol., 46: 352-4(1968).

The biological effect on 237 descendants of women exposed to small x-ray doses was assessed. All the women, aged 14 to 40 yr, had an x-ray examination involving the gonadal region between 1924 and 1930, some in utero. The examinations were mainly urological or to determine fetal position. The doses for the examinations were below 5 R. Children irradiated in fetal life as well as children conceived after irradiation were included. Estimates of vitality were calculated on the basis of the number of births and miscarriages. Malformations were especially noted. The results showed no evidence of reduced vitality or increased morbidity. Among the 215 children only the following malformations were found: one case of thorax deformity, one of web feet, and one with defective teeth. However, four had anomalies of the eyes, both in the group irradiated in utero and in those conceived after irradiation. These anomalies included one case each of primary atrophy of the iris, complete coloboma of the iris, symmetrical thickening of the pupil margins, and segmented heterochromy. The incidence of four rare anomalies in 215 persons was striking, but the role of irradiation in their induction was unknown. (BBB)

10105 LIGHT AND RADIATION PROBLEMS IN INSTALLATIONS WITH HIGH LEVELS OF ILLUMINATION. Muench, W.; Steck, B. Gesundh.-Ing., 88: 270-80(Sept. 10, 1967). (In German).

The continual rise in lighting standards that has resulted from wider appreciation of occupational physiology, advanced working processes, and increasing intellectual and visual activity is pointed out. The effects of visible and invisible radiation on man (brightness, glare, reflex glare, erythema, and conjunctivitis) are discussed and a guide given to the calculation of thresholds of illumination level for given biological and heat radiation effects. Following a brief evaluation of the light output and energy balance of the chief light sources, measures for avoiding undesirable biological effects in the uv and infrared regions are discussed. (CIS)

10106 EFFECTS OF RADIATION ON MAN. Upton, Arthur C. (Oak Ridge National Lab., Tenn.). Annu. Rev. Nucl. Sci., 18: 495-528(1968).

The literature concerning the effects of radiation on man is reviewed. For purposes of convenience, the types of radiation injuries are classified into somatic (early and late) and genetic. The injuries substained by individual tissues and organs following exposure, the biochemical changes occurring, the concepts of lethality and recovery, and the influence of dose and dose rate on the mature of the injury sustained are also discussed. The effects of radiation on man, discussed in individual sections of the review, include the following: the effects of prenatal irradiation on growth and development and cancer incidence; the effects of radiation on longevity; effects on incidence of skin cancer, leukemia, thyroid, bone, and pulmonary tumors, and a variety of other neoplasms; effects on incidence of cataracts; and genetic effects. The evolution of radiation protection standards is also reviewed. (E.R.B.)

10107 IMPACT OF THE ATMOSPHERIC ENVIRONMENT ON THE INTEGUMENT OF MAN. Daniels, F. (Cornell Univ., Medical Coll., New York). pp 103-10 of the 4th International Biometeorological Congress, New Brunswick, N. J., Aug. 26–Sept. 2, 1966.

A discussion of human skin with regard to characteristics that are significant in adaptation to the environment is presented. The importance of the blood supply and the sweat glands of the skin is emphasized in a discussion of the role of the skin in regulating body temperature. Adaptations to arctic and tropical environments are described. The role of uv radiation from the sun in vitamin D synthesis and destruction of microorganisms is pointed out; uv radiation also causes skin cancer and harmful effects of aging. Targets for uv damage are DNA, RNA, proteins, lipid membranes, and urocanic acid of the skin. (H.L.W.)

Radiation Effects on Plants

Refer also to abstracts 9826, 9842, 9853, 9854, 9908, 9910, 9912, 9913, 9917, 9919, 9921, 9922, 9924, 9983, 9984, and 10048.

10108 (NYO–2043-173) THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Annual Report. Moh, Carl C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)). July 1, 1968. Contract AT(30-1)-2043. 83p. Dep. CFSTI.

The status and results of research on the applications of nuclear energy to agriculture are presented. Separate abstracts were prepared on five of the 12 investigations reported. The other investigations were concerned with aspects of cytogenetics, plant physiology, entomology, and soil chemistry. (E.R.B.)

For abstracts of individual papers see: 9912, 9913, 10039, 10109, and 10129.

10109 (NYO–2043-173, pp 1-3) RADIOSENSITIVITY OF TROPICAL PLANT SPECIES. Moh, C. C.; Nanne, H. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The radiosensitivity of tropical and other plant species was determined. Two criteria were established to yield information on the critical γ-dose level at which a species could maintain its continuity in a plant community. These criteria were: for vegetatively propagated species; the maximum daily dose at which the plants can survive until their natural death; and for seed propagated species; the maximum daily dose at which the plants can produce seeds to complete their life cycle. The chronic cesium-137 γ-radiosensitivity of three gymnosperm and 12 angiosperm species is given. (E.R.B.)

10110 (ORNL-TM-2310) NEUROSPORA EXPERIMENT P-1037. Quarterly Progress Report to the National Aeronautics and Space Administration, October 1–December 31, 1967. de Serres, Frederick J. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 70p. Dep. CFSTI.

The assays of conidia from heterokaryotic cultures of Neurospora crassa failed to reveal a difference between those conidia subjected to orbital flight and exposed to γ radiation in the weightless condition and those conidia similarly irradiated in a duplicate vehicle on the ground under normal gravity conditions. The assays provided estimates of survival of each type of conidia obtained in a heterokaryotic culture, estimates of the incidence of specific locus mutations in the ad-3 region among surviving heterokaryotic conidia, and estimates of the incidence of recessive lethal mutations among the surviving heterokaryotic conidia. The results with specific locus mutations must be considered tentative pending the completion of tests permitting the classification of mutants and estimation of the incidence of ad-3 mutants from each of the different distinguishable classes. (auth)

10111 (ORO–661, pp 103-27) PLANT STUDIES. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.).

GAMMA RADIATION — effects on survival of soybean seedlings following seed exposure, cesium-137
— effects on barley, oat, and wheat plants following seed exposure, mutagenic
— effects on seeds and spores, cooperative use of irradiation facilities to determine latent cesium-137 and cobalt-60
— effects on chlorogenic acid in vitro, effects of dose on cesium-137

METHANESULFONIC ACID, ETHYL ESTER — effects on wheat plants following seed treatment, mutagenic

NEUTRONS, FISSION — effects on survival and yield of soybean seedlings following seed exposure, field studies of
— effects on barley, oat, and wheat plants following seed exposure, mutagenic
— effects on seeds and spores, cooperative use of irradiation facilities to determine latent
— effects on chlorogenic acid in vitro, effects of dose on
— effects on content of IAA-oxidase in garden pea seeds and sunflower fruits

RADIATION — effects on nuclear volume of blackeyed peas, flax, and oats, effects of pretreatment with ice-water on determination of (E.R.B.)

10112 INFLUENCE OF SEED COATS ON THE EFFECT OF X-RAYS ON THE EMBRYO OF TRITICUM DURUM DESF. Ortu, Alba Marchioni; Meletti, Paolo (Univ., Cagliari, Italy). G. Bot. Ital., 101: 241-2(1967). (In Italian).

Seeds of "durum" wheat "Cappelli", presoaked in distilled water at 20°C for 24 hr in the dark, were treated with x rays 0.5, 1, 2, 4, and 6 kR. Before irradiation, seeds were divided into three groups; normal seeds with covered embryos; seeds irradiated with subsequent removal of seed coats (pericarp and spermoderm); seeds irradiated after having removed the seed coats of the embryos. Controls were also prepared. The material was sown in sterilized soil and kept in a thermostatic chamber at 20°C, in the dark, for 7 days. After 4 and 6 days the seedling emergence was registered, and after 7 days the seedlings were measured. Of particular interest is the remarkable depressing effect on the growth of seedlings coming from bared and irradiated embryos; this effect is induced especially on the root, by x rays at 2, 4, and 6 kR. No difference was found, on the contrary, among the seedlings coming from irradiated and bared embryos and those coming from irradiated controls. (tr-auth)(TSS)

10113 EFFECT OF MOISTURE STABILIZATION PERIOD ON RADIOSENSITIVITY OF BARLEY SEEDS. Notani, N. K.; Gaur, B. K.; Joshi, R. K.; Bhatt, B. Y. (Bhabha Atomic Research Centre, Bombay). Radiat. Bot., 8: 375-80(Dec. 1968).

An experiment was designed to study the nature of the increase in radiosensitivity at high moisture levels. Seed lots were stabilized for different periods (2 to 16 weeks) so as to attain uniformly high (~25%) water content and were then irradiated with ^{60}Co γ-rays (28.56 and 42.84 kR for growth studies and 28.0 and 40 kR for cytological experiments). Unirradiated controls showed little difference in growth as a result of differences in equilibration periods. On the other hand, irradiated seeds showed an increase in radiosensitivity with increasing equilibration period. The role of any alteration in the respiration and/or chromosomal duplication was then assessed. The change in respiration rate (presumably affecting the intracellular oxygen tension) was apparently better correlated with the increase in radiosensitivity. (auth)(UK)

10114 INFLUENCE OF THE SEED COATS ON THE GROWTH OF THE EMBRYO IN TRITICUM. Ortu, Alba Marchioni (Univ., Cagliari, Italy). G. Bot. Ital., 101: 305-6(1967). (In Italian).

The influence of the seed coats on embryo growth of durum wheat "Cappelli" was investigated. Embryos of seeds presoaked for 24 hr in the dark at 23°C, were deprived of pericarp (uncovered embryos) or of pericarp together with spermoderm (bared embryos): afterwards, they were irradiated with 1, 2, and 4 kR of x rays and were grown in petri dishes on filter paper for 3 days, in the dark at 23°C. Seedlings, coming from uncovered embryos, are significantly longer than controls; on the contrary, the seedlings coming from the embryos, which have been bared, do not differ from control seedlings, though they are in a condition of precarious equilibrium. This condition is emphasized when the seeds with the bared embryo are treated with x rays: they originate seedlings significantly shorter than those coming from irradiated controls and from irradiated uncovered embryos. These two types of seedlings, on the contrary, coming from seeds irradiated with 1 kR, are longer than controls (dose 0 kR), as a consequence of a "disinhibition" effect. (auth)

10115 ACTION OF X RAYS ON THE STRUCTURAL AND CYTOCHEMICAL ORGANIZATION OF WHEAT ROOTLETS. Fursov, V. I.; Autenshlyus, A. I. (Kazakh State Univ., Alma-Ata, USSR). Vestn. Sel'skokhoz. Nauki, Min. Sel. Khoz. Kaz. SSR, 8: No. 1, 15-19(1965). (In Russian).

Soft wheat sprouts, after 5-day growth in Petri dishes containing sand at room temperature, received a 3000 R dose of 165 KV x rays, while control samples were not irradiated. The irradiated and control seedlings were allowed to grow 10 days. The fixation of primary rootlets of control and experimental sprouts was performed in alcohol-chloroform mixture (2:1) on the fifth and 10th days of germination, whereupon the fixed material was cut on a microtome to 8 μ thickness for examination after the usual staining procedure. The cytophotometric tests showed that x irradiation had a negative effect on the growth and structure of cells of the primary rootlets. X rays suppressed nucleic acid and protein metabolism, and, to a lesser degree, their action seemed to adversely affect the carbohydrate metabolism of cellular protoplasm in primary rootlets and sprouts during their heterotrophic stage. The sprouts and rootlets were able to continue their normal growth for two or three days after irradiation, whereupon a rapidly progressive deterioration of germination set in. (BBB)

10116 EFFECT OF GAMMA-RAYS ON CORN SEEDS. Diaconu, P.; Banu, M.; Cirstea, S. An. Inst. Cercet. Pentru Cereale, Plante Teh. Fundulea, 34: 343-52(1966). (In Rumanian).

The effect of ^{60}Co irradiation on corn seeds has been studied at the Fundulea Research Institute for Cereals and Technical Plants during 1964 to 1966. The double-cross hybrid 311 and its parental forms were irradiated with γ-ray doses of 300, 500, 750, and 1250 R. Dry seeds as well as seeds moistened for 36 hours were irradiated. The influence of radiation on the crop was studied in comparative cultures in the year of irradiation and in the next year. A stimulating effect was found in seeds moistened for 36 hours and irradiated in doses of 300 R. Significant yield increases were found in the lines L 47 and L 48. Doses of 500, 700, and

1250 R negatively affected grain yield and pollen fertility. The stimulating effect of the 300 R dose was very weak during the second year following irradiation, whereas doses of 500, 700, and 1250 R had a negative effect in the second year after irradiation. Hybrids developed by crossovers between plants irradiated in doses of 300 R, exhibited heterosis similar to controls, at times being even more productive. The use of γ radiations is a modern technique of raising inbred line productivity. (auth)(Rom. Sci. Abstr.)

10117 STUDY OF THE IMPROVEMENT OF THE METHOD FOR INTERNAL RADIATION BY RADIOACTIVE PHOSPHORUS APPLIED IN FRUIT SELECTION. Pejkic, B. (Faculty of Agriculture, Belgrade). Arh. Poljopr. Nauke, 18: 50-8(1965). (In Serbo-Croatian).

Methods are described for the injection of ^{32}P directly into branches of trees. Applications of the method in studies on the effects of various doses of internal radiation on the florescence and fruit yield of Jonathan apples are reported. (C.H.)

10118 EFFECTS OF IRRADIATION ON WHEAT DURING THE FIRST YEAR OF TREATMENT. Grinvald, C.; Diaconu, P.; Banu, M. An. Inst. Cercet. Pentru Cereale Plante Teh. Fundulea, 34: 47-58(1966). (In Rumanian).

A study was carried out on the Bezostaia 1 wheat variety and on some lines developed at the Fundulea Research Institute for Cereals and Technical Plants, irradiated in the U.S.A. with thermal neutrons for 3, 4½, and 6 hours, and in the German Democratic Republic with x rays in doses of 10, 15, and 20 kr. The action of ionizing radiation diminished the vitality of wheat plants, reducing the percent of emergence and dormancy and increasing the rate of losses during the period of growth. In the first stages of development it was found that the 3rd to 5th leaves emerged prior to controls. Root length, foliage area, number of tillers and of fertile spikelets, plant height, and number and weight of seeds in the main ear recorded lower values than in controls. The differences varied with the dose. A more significant radiobiological effect was recorded following irradiation with thermal neutrons. Changes occurring in the morphology and fertility of X_2 and N_2 plants resulted from chromosomal aberrations that disturbed the natural process of somatic and reductional division. Besides the types of aberrations described in the speciality literature, multipolar spindles were observed forming polyades with microspores, containing a variable chromosomal number. (Rom. Sci. Abstr.) (auth)

10119 DICTYOSTELIUM DISCOIDEUM: A GAMMA-RAY RESISTANT ORGANISM. Deering, R. A. (Pennsylvania State Univ., University Park). Science, 162: 1289-90(Dec. 13, 1968).

The vegetative cells of the slime mold Dictyostelium discoideum were extremely resistant to ^{60}Co γ rays. The survival curve had a shoulder at low doses and a 10 percent survival dose of 300 kilorads in air. Dose fractionation experiments indicated that repair of sublethal damage was an important factor in this resistance. (auth)

10120 MUTATION INDUCTION AS INFLUENCED BY DEVELOPMENTAL STAGE AND AGE. Mericle, L. W.; Mericle, R. P. (Michigan State Univ., East Lansing). Abh. Deut. Akad. Wiss. Berlin, Kl. Med., No. 2, 65-77(1967). (COO-1400-9).

A review of recent literature on the genetic effects of irradiation of embryonic tissue of barley (Hordeum distichum) and a hybrid Tradescantia (T. occidentalis and T. ohiensis) is presented. Dominant lethality was observed in barley following acute γ irradiation of specific stages in embryonic development. Frequencies of lethality were inversely correlated with the developmental stage of the embryo. Recessive lethality occurred with the highest incidence in the second generation following irradiation of mid-proembryo stages containing 60 to 500 cells. Reproductive efficiency factors were calculated for γ-irradiated proembryos of barley and these were correlated with mutation frequency. Estimates of meristematic capital for the future germinal tissue were originally based on radioinduced mutations for albinism, leaf abnormalities, and dwarfism; more recently data from head sterility and recessive lethality were added. Changes in mutation rate associated with cluster age were studied using irradiation at various stages of bud development of Tradescantia. (H.L.W.)

Radiation Effects on Microorganisms

Refer also to abstracts 9842, 9853, 9860, 9890, 9894, 9896, 9918, 9925, 9926, 10023, 10070, and 10091.

10121 PARTIAL IRRADIATION OF BACTERIAL SPORES. Lefebvre, Gerald Marcel. Newark, Del., Univ. of Delaware, 1967. 59p.

Thesis.

Bacillus megaterium spores of strain 14581 (ATCC) were irradiated dry and in vacuum with low-energy electrons. The energies used were such that the maximum electron range was less than the smaller spore dimension. The degree of penetration was controlled by selecting the electron energy. Attempts were made to induce the spore to undergo some of the changes associated with germination by electron bombardment. The attendant property chosen for observation was the change in optical density of a suspension of the spores. An outer layer about 350 Å thick was found to be insensitive to energetic electrons with respect to this property. Penetration beyond this layer revealed two regions that could be associated with this spore property. These two regions were defined by a change in the response of the loss in optical density as a function of the incident electrons. The separation of the two sensitive regions appeared to be at a depth of about 1300 Å. It was thought desirable to try to separate, on the basis of electron energy, the regions sensitive with respect to loss of optical density and those sensitive with respect to viability. Two regions of different sensitivity were found with respect to viability that coincided with the two regions sensitive with respect to loss of optical density. The outer layer showed the same dose response for both properties, suggesting that the same material might be involved in both cases. In the inner region, a large difference in the doses necessary to produce these two effects was seen. It was therefore concluded that two separate mechanisms were involved. Analysis of the data indicated that the inner region was centrally located. The depth at which its separation from the outer layer occurred (about 1300 Å) suggested very strongly that this outer region was not part of the nucleus. This would then establish that it was possible to kill a spore by hitting nonnuclear material. By the same token, it was seen quite clearly that loss of optical density would be induced by damaging the spore in its cytoplasm, and that less energy was required to do so here than in the outer layer. (auth)(Diss. Abstr.)

10122 MECHANISM OF CONJUGATION AND RECOMBINATION IN BACTERIA. II. RECOMBINATION DEFICIENCY IN EDEINE-RESISTANT Hfr STRAINS. Wlodarczyk, Miroslawa; Piekarowicz, Andrzej; Borowski, Edward; Kunicki-Goldfinger, Wladyslaw J. H. (Univ. of Warsaw). Acta Microbiol. Pol., 17: 121-8(1968).

Ultraviolet sensitivity was examined in edeine-resistant mutants of four Hfr strains of Escherichia coli that were recombination-deficient. The mutants were able to transfer their genophores into the female cells, as seen by the normal efficiency of zygotic induction of λ prophage and by the presence of ^{14}C-labeled donor DNA in female exconjugants. The deficiency was not due to inhibition of transfer, but to effects on the recombinational event itself. The recombination frequency was decreased more than 1000-fold. The recombination deficient mutants of Hfr strains retained also their susceptibility to male-specific bacteriophage f_2. Their sensitivity to uv irradiation did not change. The implication of these results on the mechanism of recombination is discussed. (BBB)

10123 INACTIVATION STUDIES OF ENZYMES AND BACILLUS SUBTILIS SPORES USING LOW ENERGY PROTONS. Person, Stanley Richard. New Haven, Yale Univ., 1957. 97p.

Thesis.

The ranges of low voltage protons in protein were measured experimentally in the energy region from 1.8 to 75 keV. The enzymes trypsin, ribonuclease, and invertase served as stopping mediums and detectors. The resulting ranges corresponding to this energy region are 175 to 6000 A. If a $z^{\frac{1}{2}}$ range dependence is assumed, range measurements agree to within 20% with those determined experimentally for air, hydrogen, and aluminum. Proton straggling is calculated to be 10 to 20%. The effect of low voltage protons on the viability of Bacillus subtilis spores was studied for proton penetrations into the spore of 175 to 6000 A. The cross sections, calculated using target theory, indicated a spore structure that was consistent with existing knowledge. These data indicate that the spore has a radiation resistant outer coat that is about 200 A thick. There is a region immediately inside of this layer that contains a large number of radiation sensitive targets, as shown by a rapid rise in the spore viability cross section. The cross section is still increasing at a depth of penetration corresponding to the spore radius. Therefore, the radiation sensitive material probably extends to the center of the spore. Comparison with low voltage electron data indicates the possibility of an energy requirement for the inactivation of each target. (Disser. Abstr.)

10124 PROPERTIES OF THE GROWING POINT REGION IN BACTERIA AND DNA REPLICATION IN PPLO. Smith, Douglas Wemp. Stanford, Calif., Stanford Univ., 1968. 224p.

Thesis.

Normal DNA replication, DNA replication following uv irradiation, and selected aspects of the regulation of DNA synthesis in

pleuropneumonia-like organisms (PPLO) were studied, using a strain of the PPLO Mycoplasma laidlawii B adapted to a semi-defined casein hydrolysate medium. Physiological studies showed that in the absence of thymidine, the cells lost viability exponentially with a two hr half-life after a 10 to 15 hr lag (thymineless death). Removal of glucose prevented this inactivation. When thymidine was removed in the absence of protein synthesis, inactivation with seven to eight half-life, to less than 0.5% survival, was observed. DNA replication was examined by density labeling the DNA with the thymidine analog, 5-bromodeoxyuridine, and analyzing the DNA density distribution following equilibrium sedimentation in CsCl density gradients. Using both sheared DNA and intact chromosomes isolated in CsCl gradients, it was shown that the DNA was replicated sequentially and semi-conservatively in unirradiated cells. When irradiated with uv light, Mycoplasma laidlawii B died exponentially with a mean lethal dose of about 25 ergs/mm², and this loss of viability was photoreactivable. Visible light itself caused some loss of viability. After low doses of uv irradiation, simultaneous degradation and synthesis of DNA, both semi-conservative and nonconservative syntheses were observed. Using zone sedimentation in sucrose density gradients containing a shelf of 62% sucrose, pulse-labeled DNA from the bacterium Escherichia coli strain TAU-bar was isolated in a rapidly sedimenting complex. The complex, found in a band at the top of the shelf, was separated both from prelabeled bulk DNA fragments, found at the top of the gradient, and from whole cells and large cell debris, found in a pellet at the bottom. The complex was resistant to limited pronase digestion but was disrupted by 1% deoxycholate, suggesting that the nascent DNA was complexed with a lipid structural element in vivo. Characterization of the complex in CsCl equilibrium sedimentation suggested strongly that such DNA was from the growing point region of the bacterial chromosome. Similar studies with Mycoplasma laidlawii B showed that a rudimentary complex was present, but that this complex was more difficult to isolate than was that of Escherichia coli. The PPLO complex was disrupted both by 0.1% sarkosyl and by pronase treatment. (Disser. Abstr.)

10125 EXAMINATION OF X-RAY EFFECT UPON DEVELOPMENT OF VACCINE VIRUS IN CHICK EMBRYO. Kamalyan, L. A.; Ter-Pogosyan, R. A.; Vartevanyan, Zh. Ts.; Martirosyan, G. A. Vop. Radiobiol., Sb. Tr., 5: 317-21(1965). (In Russian).

X irradiation (700 to 900 R) causes delay in development and death of some chick embryos. The extent of pathologic changes increases due to the effect of irradiation and vaccine virus. The reproduction of vaccine virus does not change at a dose of 700 R but it is depressed at doses of 800 and 900 R. (auth)

10126 DEVELOPMENT OF VACCINE VIRUS IN IRRADIATED CELLS OF DIFFERENT TISSUE CULTURES. Kamalyan, L. A.; Ter-Pogosyan, R. A.; Engoyan, M. N. Vop. Radiobiol., Sb. Tr., 5: 39-43(1965). (In Russian).

Virological and immunofluorescence examinations carried out on three different tissue cultures show that x-ray irradiation (5 Ci) 24 hours before vaccination has no effect upon the development of vaccine virus. (auth)

10127 EFFECT OF DEUTERATION ON THE GROWTH AND ANITBIOTIC PRODUCTION OF A NUMBER OF STRAINS OF PENICILLIUM. Mohammed, Kasheed; Nona, Daniel A.; Blake, Martin I. (Univ. of Illinois, Chicago). J. Pharm. Sci., 57: 2049-52(Dec. 1968).

Thirteen strains of two species of Penicillium were surveyed for their ability to grow and produce antibiotic in a medium of high concentrations of heavy water. Mycelial dry weights, pH variation, and penicillin potency were noted over a 90-day study period. In the deuterio cultures autolysis and penicillin degradation did not occur. Phenylacetic acid was found to stimulate penicillin production in both the protio and deuterio cultures. (auth)

Radiosterilization and Radiopreservation

Refer also to abstracts 9910, 9943, 10040, 10042, and 10108.

10128 (JPRS-47070) AGRICULTURAL PESTS STERILIZED BY GAMMA-RADIATION. Andreev, S. V.; Martens, V. K.; Molchanova, V. A.; Saldan, N. L. Translated from Radiobiologiya, 8: No. 5, 742-6(1968). 11p. CFSTI.

Applications of γ-radiosterilization for the control of insects that destroy agricultural crops in the U. S. S. R. are discussed. Data are presented on the optimum ^{60}Co γ-dose for the radiosterilization of bean weevils for use in the sterile male technique of insect control. (C.H.)

10129 (NYO-2043-173, pp 49-51) STUDIES ON THE BIOLOGY AND STERILIZATION OF THE COFFEE LEAF MINER, LEUCOPTERA COFFEELLA GUER. Katiyar, K. P. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Previous studies indicated that the pupal stage of the coffee leaf miner (Leucoptera coffeella) was not suitable for inducing dominant sterility in adults. Experiments are currently underway to determine the γ-dose-response curve for male and female coffee leaf miners using moths from the colony. The effects of γ-irradiation on sexual vigor and mating competitiveness in male moths will be determined. (E.R.B.)

10130 (TID-24332) SHIPBOARD IRRADIATOR STUDIES. Final Report, May 16, 1966-August 31, 1967. Carver, Joseph H.; Connors, Thomas J.; Ronsivalli, Louis J.; Holston, John A. (Bureau of Commercial Fisheries, Gloucester, Mass. Technological Lab.). Dec. 1968. Contract AT(49-11)-1889. 55p. Dep. CFSTI.

The feasibility of radiation processing North Atlantic fish at sea was investigated. A portable ^{60}Co γ-irradiator was installed aboard a ship and was used to radiopasteurize clams, haddock, and, to some extent, several other species. Results of these tests indicated that by irradiation at sea with doses of 50 to 200 Krads it was possible to land iced fish of higher quality than is now landed. Ten-day old irradiated haddock were comparable in quality when landed to one to two-day iced, nonirradiated fish. The average shelf life of fish irradiated at sea was similar to that of fish irradiated on land, about 3 to 4 weeks. No major problems were experienced with the irradiator. (C.H.)

10131 (UH-235-P-5-3) DOSIMETRY, TOLERANCE, AND SHELF LIFE EXTENSION RELATED TO DISINFESTATION OF FRUITS AND VEGETABLES BY GAMMA IRRADIATION. Period Covered: June 1, 1966-May 31, 1967. Akamine, E. K.; Brewbaker, J. L.; Buddenhagen, I.; Hilker, D.; Kinch, D.; Moy, J.; Ross, E.; Spielmann, H.; Upadhya, M. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture). Contract AT(04-3)-235. 160p. Dep. CFSTI.

Separate abstracts were prepared for 17 sections of this report on radiation processing of tropical fruits. (C.H.)

For abstracts of individual sections see: 9943 and 10132-10147.

10132 (UH-235-P-5-3, pp 3-13) BIOCHEMICAL CHANGES DURING STORAGE OF GAMMA IRRADIATED PAPAYA. Upadhya, Mahesh D.; Brewbaker, James L.; Ching, Ken W. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Biochemical studies of papaya γ-irradiated at doses up to 500 Krads followed by three and six days of post-irradiation storage at 65°F showed no appreciable reduction in total proteins, percent of total soluble solids, or reducing sugars. The phenolic substances did show a slight reduction after six days of storage. A very significant increase in the peroxidases was observed in fruits irradiated with 400 and 500 Krads after three and six days of post-irradiation storage. In contrast, after three days post-irradiation storage the proteolytic activity of the enzyme, papain, was reduced about 40%. (auth)

10133 (UH-235-P-5-3, pp 14-17) CONTROLLED ATMOSPHERE STORAGE OF IRRADIATED PAPAYAS. Akamine, Ernest K.; Goo, Theodore (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

In preliminary experiments, freshly harvested mature green to ¼-colored papayas were hot water-dipped and then γ irradiated at a dose of 100 Krad prior to storage under controlled atmospheres for six days, followed by storage in air at room temperature. Initial storage under one to four percent oxygen at 60°F delayed surface color development in subsequent storage in air at room temperature. There was some evidence of decay control in irradiated fruits by initial low oxygen tensions. Oxygen tensions of one and three percent were more conducive to off-flavor and off-aroma development than higher oxygen tensions. (auth)

10134 (UH-235-P-5-3, pp 18-20) THERMAL PROPERTIES OF PAPAYA. Kinch, D. M.; Stoutenberg, C. C. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

The processing of γ-irradiated papaya for mainland shipment needs the addition of a thermal treatment for added protection against quality deterioration caused by post-harvest disease organisms. The design of equipment for the thermal treatment of papaya is discussed. (C.H.)

10135 (UH-235-P-5-3, pp 21-5) THERMAL TREATMENT OF IRRADIATED PAPAYA. Kinch, D. M.; Stoutenberg, C. C. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Ripeness and physical appearance of papayas were checked following processing by thermal treatment only, γ-irradiation only, or thermal plus γ irradiation. No interactions between treatments

were found. Irradiation, with or without thermal treatment, delayed ripening, i.e., produced a firmer flesh after 15 days storage, simulating transport and market conditions. Radiation, as the only treatment, at 75 to 100 Krad provided little, if any, protection against disease organisms during storage. (auth)

10136 (UH-235-P-5-3, pp 26-53) MARKET DEVELOPMENT FOR IRRADIATED PAPAYA. Spielmann, Heinz (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

A market survey concerned with the market behavior of papaya at the retail level was carried out in two California test cities. The survey revealed that papaya on the mainland market are much less sensitive to price than to supply and display. Therefore, any market developmental activity at the present time should concentrate on individual store promotions, attractiveness of display, supply sufficiency, etc. Market development should first be centralized in a relatively small area and eventually expanded as market experience and popular acceptance of the product develops over time. A telephone survey was designed to determine popular attitude toward consumption of irradiated foods and what effect γ irradiation of a product would have on its market behavior. The results of the survey showed that γ irradiation would have no serious effects on the demand of a product, in the long run. These results would be applicable to papayas by extrapolation. (auth)

10137 (UH-235-P-5-3, pp 54-65) STUDIES OF GAMMA-IRRADIATION IN RELATION TO POST-HARVEST DISEASES OF PAPAYA AND MANGO. Kojima, E. S.; Buddenhagen, I. W. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Gamma irradiation had little effect on disease incidence or severity on papaya fruit at recommended doses. Irradiation combined with 2-aminobutane fumigation provided better disease control than either treatment alone. Disease incidence and severity on mango were reduced by irradiation alone but reduction was significant only above 240 Krads. Spores of post-harvest pathogens were differentially tolerant to irradiation, with Rhizopus being the most resistant. Observable cytoplasmic changes in fine structure occurred in spores irradiated at lethal doses. (auth)

10138 (UH-235-P-5-3, pp 66-9) EFFECTS OF GAMMA IRRADIATION ON CAROTENOID RETENTION IN PAPAYAS AND MANGOES. Hilker, Doris M.; Wong, Eunice (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Cryptoxanthin of papaya and β-carotene of mango were determined following γ irradiation at doses to 500 Krads. The retention of these vitamin precursors was not significantly affected immediately following irradiation of the $^3/_4$ to edible ripe fruits. (auth)

10139 (UH-235-P-5-3, pp 70-84) POST-IRRADIATION STORAGE CHANGES IN IRRADIATED PIRIE MANGO. Upadhya, Mahesh D.; Ching, Ken W.; Brewbaker, James L. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Studies were made to evaluate the effects of storage periods and temperatures on certain biochemical characteristics of Pirie mangoes following γ irradiation at doses varying from 25 to 150 Krads. Irradiation of green fruits severely affected normal ripening processes, particularly in relation to the increase in total soluble solids and sugars. Mature-green fruits ripened normally following irradiation up to 150 Krads and post-irradiation storage at 65°F, but ripening was slightly delayed when these fruits were stored at low temperatures (45 to 55°F) following irradiation. These studies confirmed that mature-green fruits of Pirie mangoes following irradiation treatments with doses well about disinfestation dose level (75 to 100 Krads for seed weevil) did not show any adverse effects with respect to certain biochemical characteristics that contribute to the taste of the fruit. (auth)

10140 (UH-235-P-5-3, pp 85-94) BIOCHEMICAL CHANGES IN GAMMA-IRRADIATED PINEAPPLES. Upadhya, Mahesh D.; Brewbaker, James L.; Ching, Ken W. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Pineapple fruits of the variety Smooth Cayenne were γ-irradiated at doses up to 500 Krads and stored for three and six days at 65°F. The fresh, shell, and crown leaves were analyzed for total soluble solids, titratable acids, total phenolics, chlorogenic acid content, anthocyanins, and chlorophylls. The data on these aspects are presented and discussed in relation to the radioinduced bronzing of the shell and the crown leaves during post-irradiation storage. (auth)

10141 (UH-235-P-5-3, pp 95-104) COMPARATIVE STUDY OF IRRADIATED SUMMER AND WINTER PINEAPPLES UNDER VARYING STORAGE PERIODS AND TEMPERATURES. Upadhya, Mahesh D.; Brewbaker, James L.; Ching, Ken W.; Lin, Mary (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

The biochemical studies made of summer and winter pineapple fruits γ-irradiated at 30, 40, and 50 Krads and stored at three different storage temperatures did not show any appreciable difference among the treatments. The present findings when evaluated with respect to changes in the physical characteristics showed the optimum storage condition to be 45° to 55°F, with 90% RH. The combination of 40 Krads and storage temperatures of 45° to 55°F was most desirable in delaying changes in certain biochemical characteristics associated with physiological breakdown of the fruit without inducing any undesirable changes in the physical or biochemical characteristics evaluated. (auth)

10142 (UH-235-P-5-3, pp 105-14) POST-IRRADIATION STORAGE RECOVERY OF PINEAPPLE FRUITS FROM INDUCED CYTOTOXICITY FOLLOWING DISINFESTATION DOSES OF GAMMA IRRADIATION. Upadhya, M. D.; Makinen, Y.; Brewbaker, J. L. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Gamma irradiation (30, 50, 100, and 500 Krads) of pineapples led to the production of cytotoxic substances, that caused a significant decrease in the mitotic frequency and increase in the frequency of the chromonsome breaks when tested in onion root tips. After post-irradiation storage of eight days at 18°C, the pineapples that had received 30 and 50 Krads did not exhibit these cytotoxic effects, whereas no change occurred in the fruits that had received 100 and 500 Krads. These observations indicate an autotoxicopexic mechanism in pineapple fruits that neutralizes the cytotoxic substances in the moderately irradiated fruits after the post-irradiation storage of eight days, possibly caused by the enzymatic activity not destroyed by low doses of irradiation. (C.H.)

10143 (UH-235-P-5-3, pp 115-19) EFFECT OF IRRADIATION ON AVOCADOS. Akamine, Ernest K.; Goo, Theodore (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Forty-seven varieties of Hawaiian avocados were tested for tolerance to γ irradiation at the disinfestation dose of 33 Krads. Twenty-one of these varieties were previously tested. All were injured by irradiation under ordinary conditions of treatment and post-treatment storage. Attempts were made to improve the tolerance by supplementary treatments such as cooling and heating the fruits during irradiation, intermittent irradiation, treating fruit at riper stage, use of chemical radiation protectors, and post-treatment storage under refrigeration and humidified air storage. These treatments failed to improve the tolerance. Adding the 34 previously tested varieties to the present 26 untested ones, brings to a total of 60 the varieties that do not tolerate 33 Krads of γ irradiation. (auth)

10144 (UH-235-P-5-3, pp 120-6) SENSORY EVALUATION OF IRRADIATED BANANAS. Moy, J. H.; Ross, E.; Goo, T.; Hsia, S. T. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

A study was made on the organoleptic qualities of Hawaiian grown bananas, γ-irradiated at three stages of ripening: mature green, half-color, and full color. The objective was to evaluate the color, aroma, flavor, and texture qualities of the fruit when irradiated in the region of a disinfestation dose level, 25 to 100 Krads, and to determine if a limiting dose level could be defined for the wholesomeness of the fruit. Taste panel results showed that no significant differences were detected between the control and irradiated samples. In a few cases, some hands in the irradiated batch appeared to retain the bright yellow color longer than the control during post-irradiation storage at 55°F. No chilling injury was observed. (auth)

10145 (UH-235-P-5-3, pp 127-39) PRELIMINARY STUDIES ON RESPIRATION OF GAMMA-IRRADIATED FRESH FRUITS. Akamine, Ernest K.; Goo, Theodore (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Preliminary investigations were conducted on respiration of freshly harvested Hawaiian fruits as affected by γ irradiation. Respiratory response of fruits, irradiated in the preclimacteric phase, was characterized by an initial increase in CO_2 liberation, followed by a decrease prior to the onset of the climacteric rise associated with ripening. An inverse relation between the magnitude of the initial increase in respiration and the degree of tolerance to irradiation was indicated, e.g., the avocados, the least tolerant of the fruits investigated, exhibited the greatest initial increase in respiration, and the papayas, the most tolerant, produced the smallest initial increase in respiration. The five fruits studied were categorized in order of increasing tolerance to irradiation: avocados, sour sop, mangoes, yellow passion fruit, and papayas. This category also represents a decreasing order of magnitude of the initial increase in respiration due to irradiation. (auth)

10146 (UH-235-P-5-3, pp 140-8) BIOCHEMICAL CHANGES DURING STORAGE OF GAMMA-IRRADIATED LYCHEES. Upad-

hya, Mahesh D.; Brewbaker, James L. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Studies were made on the post-irradiation storage changes in lychee with regard to total soluble solids, acidity, total phenolic substances, reducing sugars, and total proteins. The data indicated that fruits γ-irradiated at 30, 50, or 100 Krads and stored for six days were in most respects similar to controls. Irradiation dose levels of 50 to 200 Krads led to increases in total proteins and reducing sugars, and slight reduction in titratable acidity. These changes were enhanced by higher doses. There was a general increase in phenolic substances as a result of irradiation injury. Alcohol-insoluble solids progressively decreased with doses up to 300 Krads after six days of storage. (auth)

10147 (UH-235-P-5-3, pp 149-54) SHELF LIFE EXTENSION OF FRESH POI BY GAMMA IRRADIATION. Moy, J. H.; Loy, B. B. Lee (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Subjecting fresh poi to certain doses of γ radiation extends its shelf life and eliminates the need for refrigerated storage. The feasibility of using γ radiation to stop or retard fermentation, that normally begins within the first 24 hrs following the manufacture of poi, was studied. The retardation of this fermentation process increased the market potential of poi by extending its shelf life. Commercially and laboratory prepared poi were packaged in polyethylene bags, glass jars, and tin containers to test the effects of container composition on the taste qualities of poi. They were also tested for their abilities to withstand recontamination. The tin container, vacuum-sealed to safeguard against microbial reentry and ozone production, was found to be the most effective container used. Samples of fresh poi were γ-irradiated at doses varying from 0 to 1,000 Krads, then stored at room temperature and tested daily. The indices of fermentation were determined by acidity measurements. Sensory evaluations were also run. Below 500 Krads, irradiation was incapable of completely stopping fermentation. This was probably due to the varying degrees of resistance of microorganisms to γ radiation. However, at doses of 750 Krads and above, fermentation was arrested and the shelf life of poi extended to seven days or more without refrigeration and without an increase in the acidic content. (auth)

10148 POST MORTEM DEGRADATION OF FISH MUSCLE PROTEINS: THE ROLE OF PROTEOLYTIC PSEUDOMONAS SPP. AND THEIR MECHANISM OF ACTION. Chung, Jong Rak. Seattle, Univ. of Washington, 1968. 256p.

Thesis.

When English sole fillets packaged in polymylar bags were exposed to 50 Krad of γ radiation, proteolytic bacteria were selectively killed and their population did not rise above one per cent of the total viable population during 36 days of storage at 0 to 2°C. The proteinase system of a proteolytic strain of Pseudomonas sp. was investigated as a representative of proteolytic Pseudomonas spp. of fish microflora. (auth)

10149 IRRADIATION OF QUEENSLAND FRUIT FLY PUPAE TO MEET QUARANTINE REQUIREMENTS. Shipp, E.; Osborn, A. W. (Univ. of New South Wales, Kensington, Australia). J. Econ. Entomol., 61: 1721-6(Dec. 1968).

In Dacus tryoni (Froggatt) no significant differences in radiation sensitivity were observed in 7 strains originating from Queensland and New South Wales. The most radiation-resistant physiological age of pupae extended over the last $^{3}/_{10}$ of their development. A dose of 5 krad of ^{60}Co γ rays nearly sterilized both sexes within this period; doubling this dose prevented egg laying by treated females and permitted only 6 eggs per million to hatch and none to survive when irradiated males were mated with normal females. A dose of 10 krad given to fruit as a commodity treatment would provide adequate safeguards against the spread of this pest species. (auth)

10150 RIPENING CONTROL AND STORAGE OF FRUITS BY IRRADIATION. Ogata, Kuniyasu (Univ. of Osaka). Nyu Fudo Indasutori, 10: No. 8, 7-11(Aug. 1968). (In Japanese).

The irradiation treatment of fruits, for either prolongation of their storage period or improvement of their quality, in Japan is described. Regarding the control of ripening, the effect of ripening control by irradiation is seen in those fruits having climatic rise, i.e., banana, pear, tomato, and apple. As for storage by surface sterilization, rotting germs, adhering to the surface, are sterilized, to prolong the storage period of fruits such as strawberry, citrus fruits, grapes, and cherries. (NSA of Japan)

10151 PROSPECTS OF APPLICATION OF RADIATION STERILIZATION IN VETERINARY MEDICINE. Arkhipov, V. V.; Lure, L. S.; Prokofev, N. S.; Khrushchev, V. G. Veterinariya, 42: 82-4(Dec. 1965). (In Russian).

The use of ionizing radiation for disinfection of animal feed, for livestock pest control, for sterilization of foodstuffs, water, and waste products, and for sterilization of veterinary equipment, biological preparations, and culture media is reviewed. While industrial installations widely used electron accelerators, γ-ray sources such as ^{60}Co, with higher penetrating power, were more desirable for sterilization of some products than thermal or chemical sterilization methods. Some acceptance of ^{137}Cs was also evident, in transportable outfits, because the γ energy was not as high as that of ^{60}Co; consequently, the radioprotective measures constitute a lesser problem. Plans were made to open in the USSR a large γ radiation installation (up to 500,000 Ci activity) for handling from three to 15 tons of dressing materials to be sterilized daily, such as bandages and cotton, in a package size of 43 × 49.5 × 75 cm. The methods of radiation sterilization in veterinary medicine posed a radioprotective problem to the personnel engaged in processing the material. Another possible hazard, induced radioactivity, was encountered in the utilization of materials after radiosterilization. While the first problem was solved by conventional protection methods, the second one did not arise with the sources generally used. The prospects of radiation sterilization in veterinary medicine for the control of the spread of infectious diseases among animals, such as tuberculosis, are also discussed. (BBB)

10152 THE EFFECT OF GAMMA RADIATION ON STAPHYLOCOCCUS AUREUS AUREUS IN SEAFOOD. Slabyj, Bohdan Mykola. Seattle, Univ. of Washington, 1968. 205p.

Thesis.

Commercially processed dungeness crab meat was examined for incidence of public health bacteria before and after exposure to γ radiation and storage at 1 and 5.5°C. Coagulase-positive staphylococci were present in 53% of samples of fresh crab meat but only in low concentrations. Enterococci were detected in all samples examined while coliforms were found in only 25% of the samples. Escherichia coli, Salmonella, and Shigella were not detected in any of the samples examined. The number of saprophytes was consistently low, varying between 1.5×10^4 and 1.1×10^5 cells per gram of freshly picked dungeness crab meat. There was no apparent seasonal fluctuation. Immediately after exposure to 100 and 200 Krad of γ radiation or upon subsequent storage at 1 or 5.5°C until spoiled, coagulase-positive staphylococci, salmonellae, shigellae, E. coli or coliforms were never detected in fresh crab meat. Enterococci survived radiation exposure and increased in viable count at 5.5°C storage temperature, while at 1°C they tended to decrease in viable count during the storage period. A coagulase-positive Staphylococcus, originally isolated from picked dungeness crab meat, was found to be most sensitive to ionizing radiation when suspended in buffer and least when in Brain Heart Infusion (BHI) broth, but had an intermediate response when in crab meat. Staphylococci were also tested for their ability to repair radiation damage when held at various temperatures after irradiation. Repair of damage exhibited both a temperature (37°C) and a pH (5.5) optimum. Furthermore, repair of lethal damage at 37°C required both energy and protein synthesis, while partial repair was obtained in the presence of chloramphenicol or hydroxyurea. No repair of radiation damage was observed in the presence of inhibitors of deoxyribonucleic acid (DNA) synthesis. At suboptimal temperature partial recovery was induced by chloramphenicol and hydroxyurea, while complete recovery was obtained by exposure to penicillin or ethylenediaminetetraacetate. Radiation also appeared to stimulate survivors to undertake metabolic activities that normally occurred in nonirradiated cells during logarithmic growth. (auth) (TSS)

10153 IRRADIATION: BREAKTHROUGH IN FOOD PACKAGING. Sharring, Fred A. Paperboard Packag., 52: 48; 50 (May 1967).

Advantages of food irradiation are discussed, such as, extended shelf-life, destruction of insects, sterilization, and retardation of ripening time. Difficulties of radiation processing are pointed out; for example, the requirement of complex equipment and difficulties of dose determination. Government approval of irradiated foods by the Federal Food, Drug, and Cosmetics Act is discussed. The significance of food irradiation with relation to packaging materials is discussed. In a recent year the value of corrugated-solid fiber containers, folding cartons, and set-up boxes totaled about $1.237 billion. If foods are irradiated to prevent deterioration, cheaper packaging could be used. Reduced stringencies of icing and extreme low-temperature preservation should eliminate a significant portion of the need for expensive waterproofing and wet-strength provision in fiber boxes. (H.L.W.)

10154 GAMMA RADIATION AND STORAGE TREATMENTS INFLUENCE ON PECTIC SUBSTANCES IN PEACHES. Shewfelt, A. L. (Clemson Univ., S. C.); Ahmed, E. M.; Dennison, R. A. Food Technol., 22: 111-13(June 1968).

Four varieties of fresh peaches were given γ radiation doses of 0, 100, 200, and 300 Krad and stored at 20°C for one, four, and six

days. Marked reduction in firmness occurred in fruit held for up to six days at 20°C. Irradiation reduced the firmness further. During storage, there was an increase in pectinesterase activity and water-soluble pectin and a decrease in Versene-soluble and Versene-insoluble pectin. As the radiation dose increased, there was a slight increase in pectinesterase activity and a decrease in Versene-insoluble pectin. Also, with increasing radiation dose, there was a higher proportion of water-soluble pectin after one day of storage but a lower proportion after six days. The reverse effect occurred for the Versene-soluble fraction. Storage at 2°C following irradiation reduced the rate of increase in pectinesterase activity and water-soluble pectin. At the lower storage temperature, the effects of irradiation on the proportions of Versene-soluble and Versene-insoluble pectin were more evident. The results indicated the relatively high sensitivity of pectic substances, particularly the Versene-insoluble fraction, to irradiation. This sensitivity appeared to be a major factor in the loss of firmness of irradiated peaches. (BBB)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

10155 INTERNATIONAL SYMPOSIUM ON PLUTONIUM FUELS TECHNOLOGY. PROCEEDINGS OF THE 1967 NUCLEAR METALLURGY SYMPOSIUM HELD IN SCOTTSDALE, ARIZONA ON OCTOBER 4–6, 1967. Horton, K. E.; Macherey, R. E.; Allio, R. J. (eds.). Nuclear Metallurgy, Volume 13. New York, American Institute of Mining, Metallurgical and Petroleum Engineers, Inc., 1968. 530p. (CONF-671005).

A total of 34 papers were presented at the symposium. A separate abstract was prepared for each of 27 of the papers. Seven papers were previously abstracted in NSA as 21: 44822, 21: 44935, 21: 46940, 22: 768, 22: 7804, 22: 8845, and 22: 36509. (J.R.D.)

For abstracts of individual papers see: 10162, 10176, 10177, 10192, 10195–10198, 10240, 10245–10247, 10251–10254, 10256, 10271, 10272, 10275, 10276, and 10299–10304.

10156 VYSOKOTEMPERATURNYE POKRYTIYA, TRUDY SEMINARA PO ZHAROSTOIKIM POKRYTIYAM (LENINGRAD, 26–28 MAYA 1965). (High Temperature Coatings, Seminar on Heat-Resistant Coatings, Leningrad, May 26–28, 1965). Borisenko, A. I. (ed.). Moscow, Izdatel'stvo Nauka, 1967. 228p.

Twenty eight reports are included on the problems of heat-resisting coatings. General problems on coating formation, considering preparation of heat-resisting compounds, diffusion saturation of surface elements, and coating are discussed in the first chapter. Concepts of solid phase formation on spherical surface, mechanism of protective properties of silicide coatings on molybdenum, kinetics of silicide niobium diffusion as well as preparation of Nb and Ta coatings by precipitation from a gas phase and heat-resisting coatings on Ni and graphite are covered in the second chapter. The third chapter deals with preparation of coatings in melted state considering diffusion pipe galvanization, preparation of coatings on Ti and Mo in aluminum base alloys, carbide coatings on graphite in liquid metals and alloys, gas-flame vaporized coatings of ZrO_2 and Al_2O_3 with aluminophosphate additions, and plasma coatings. Coating formation by means of polycondensation reactions and cement-ceramic mass coatings are discussed in the last three chapters. (R.V.J.)

Corrosion and Erosion

10157 (NAA-SR-Memo-12505) MERCURY RANKINE PROGRAM CORROSION AND MASS TRANSFER STATUS REPORT. Bremer, A. B. (Atomics International, Canoga Park, Calif.). June 27, 1967. 65p. Dep. CFSTI.

The current technical status of mercury corrosion and mass transfer for the Mercury Rankine Program (MRP) system is reviewed. Corrosion mechanisms are defined and grouped by their relative damage factor rankings. The dependence of corrosion on time and temperature is established by kinetic equations. The three steps of the corrosion and mass transfer cycle are described. The first, corrosion product generation, is analyzed for its characteristics in container vessels made of pure metals and of alloys, and methods of preventing corrosion by introducing additives and inhibitors into the mercury system are discussed. The second step, corrosion product growth and transport, is analyzed as to general characteristics, and data from commercial and MRP experience with growth and transport are presented. The third step, corrosion products deposition, is discussed by considering mechanisms of deposition, MRP experience with deposition, and by evaluating experimental methods for separating corrosion products. Futher corrosion product studies for mercury Rankine cycle aerospace systems are recommended. (L.C.L.)

10158 (RD/B/N-1182) PURIFICATION OF SODIUM BY OXIDE DIFFUSION ALONG AN INDUCED CONCENTRATION GRADIENT. Pugh, A. R. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Oct. 1968. 21p. Dep. CFSTI.

By applying a temperature gradient to a static sodium column a concentration gradient of oxide in solution is induced. A pool of sodium of low oxygen content is obtained at the hot end of the gradient by trapping out the diffusing oxide at the cold end. The theory for the rate of removal of oxide and the ultimate purity of the sodium pool is given for two different applied temperature gradients. The design and performance of a laboratory scale apparatus is discussed. (auth)

10159 (WAPD-TM-782) EFFECTS OF PRESSURE UPON THE CORROSION OF ZIRCALOY-4 (LWBR DEVELOPMENT PROGRAM). Kass, S. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Oct. 1968. Contract AT(11-1)-Gen-14. 30p. Dep. CFSTI.

Experiments were performed in high-temperature water and steam to evaluate the effects of pressure upon long-term corrosion performance of Zircaloy 4. Tests in 750°F steam at three different pressures showed increasing amounts of corrosion with decreasing steam pressure. The pressure dependence of the corrosion rate was noted to be negligible after short exposure periods, but the total amount of corrosion products produced was appreciably different and continuously diverging after extended exposures. Similarly, the times to transition as well as the transition weight gain values showed tendencies to increase with decreasing steam pressure. Altering the steam pressure in the 750°F steam tests did not produce any transient or long-time effects upon corrosion, and the behavior subsequent to a pressure change was found to be consistent with that noted under constant pressure conditions. Tests in 680°F water at 1500 psi and in 680°F steam at 1500 psi also showed that the amount of corrosion product is pressure dependent; more corrosion occurs in water than in steam. (auth)

10160 (WAPD-Trans-106) THE MECHANICAL STRESS OF ZIRCONIUM AND ZIRCALOY-2 BY THE CORROSION LAYER. Buresch, F. E.; Bollenrath, F. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from J. Nucl. Mater., 24: 270-80 (1967). 20p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8700. (R.C.K.)

10161 PROPERTIES OF CORROSION-STABLE NICKEL-MOLYBDENUM ALLOYS. Svistunova, T. V. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met., No. 46, 50-7(1966). (In Russian).

The effect of vanadium and niobium on the tendency to intercrystalline corrosion in Mo–Ni alloys was determined after exposing the alloy to boiling 10% HCl solution for 200 hr or to 21% HCl solution for 240 hr. The microstructure and the usual mechanical properties of the alloy were determined as a function of thermal treatment and of vanadium and niobium concentrations. The experimental results are summarized. It was found that both vanadium and niobium inhibit intercrystalline corrosion, vanadium being the more effective inhibitor. An alloy composition is recommended which is stable in boiling hydrochloric acid at all temperatures and also stable to sulfuric acid attack up to a temperature of 70°C. The presence of oxidizing agents in both acids considerably decreases the corrosion stability of the alloy. (ATD)

10162 COMPATIBILITY BETWEEN METALLIC U-Pu-BASE FUELS AND POTENTIAL CLADDING MATERIALS. Zegler, S. T.; Walter, C. M. (Argonne National Lab., Ill.). Nucl. Met., Met. Soc. AIME, 13: 335-44(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The compatibility of U–Pu-base fuel alloys with a variety of jacket materials has been investigated in connection with a program aimed at developing improved metallic fuels. The most recent work has resulted in the development of U–Pu–Zr alloys that have much improved compatibility with 304 stainless steel and other iron-base cladding materials. Specifically, U–15%Pu–10%Zr and U–18%Pu–14.1%Zr have good compatibility with 304 stainless steel at temperatures up to 800°C. (auth)

10163 THE PHYSICAL AND CORROSION-CHEMICAL BEHAVIOUR OF IVa METAL ALLOYS. Kieffer, R.; Binder, F.; Bach, H. (Technische Hochschule, Vienna). Werkst. Korros., 19: 114-20(1968). (In German).

The stability of titanium in respect of non-oxidant acids can be considerably increased by alloying it with Zr, Hf, Nb, Mo, or Re. In case of Zr, Hf, Nb, and Ta, a decisive improvement of corrosion behavior can only be attained if atomic percentage of these metals in alloys exceed 50%. In the case of molybdenum, a content from 20% upwards has passivating effect. But improvement in corrosion properties lessens machinability. A particularly effective alloying metal, even in small quantities, is rhenium. An excellent corrosion resistance and good machinability can be attained with ternary Ti–Mo–Ta alloys (with Mo + Ta accounting for some 20 at. %) and with a Ti–12Mo–1Re alloy. The alloying of titanium with Zr, Hf, V, Cr, or Mo is apt to cause, in some cases, a considerable deterioration in scaling resistance of titanium. Improvements can be obtained by using small quantities of Nb, W, and particularly Ta. Ti–Ta alloys with Ta contents up to 10 at. % have a good scaling resistance at 900°C. (tr-auth)

10164 THE CORROSION BEHAVIOUR OF IVa, Va, AND VIa METALS AS WELL AS RHENIUM. Kieffer, R.; Bach, H.; Binder, F.; Kurka, F. (Technische Hochenschule, Vienna). Werkst. Korros., 19: 312-16(1968). (In German).

The non-alloyed metals of groups IVa, Va, and VIa of the periodic system and rhenium show a high resistance against corrosion by aqueous solutions, diluted acids and alkalis. Among the IVa metals, Hf shows the highest resistance; like the other IVa metals, it is liable to be strongly attacked by hydrofluoric acid only. Titanium however, which has a high resistance against media containing chlorine or chlorides, is liable to corrode slightly at high temperatures when exposed to diluted, nonoxidant acids or alkaline solutions. Titanium has a high resistance to nitric acid only. Among the Va metals, the corrosion resistance increases greatly from V via Nb to Ta. All three metals are liable to be attacked by hydrofluoric acid; but, with the exception of V, they show a high resistance to other acids and to alkalis. Among the VIa metals, Cr is the only one to be resistant to nitric acid. Nitric acid has a moderate effect on W, and a strong effect on Mo. Yet Mo and W have a high resistance to all other acids, including hydrofluoric acid. Alkalis are liable to attack all VIa metals. Rhenium is a metal with high corrosion resistance. It is only attacked by nitric acid a high temperature, and by alkalis. (tr-auth)

10165 INVESTIGATION OF THE OXIDATION OF ALLOYS OF NIOBIUM WITH VANADIUM AND MOLYBDENUM. Lazarev, E. M.; Prokoshkin, D. A.; Basil'eva, E. V. (Inst. of Metallurgy, Moscow). Zh. Prikl. Khim., 41: 1926-31(Sept. 1968). (In Russian).

By investigation of the combined influence of V (up to 5 wt %) and Mo (up to 10 wt %) on the oxidation of niobium in air at 900 to 1200°C, it was established that V and Mo, in quantities of not more than 5 wt % each, decrease the oxidation rate. Kinetics were studied to develop equations for the relation of temperature to oxidation rate and to determine the values of the effective activation energy of the process. X-ray analysis of the scale on the alloys showed that it is $(Nb, V, Mo)_2O_5$ with a monoclinic structure. Its lattice parameters decreased with increasing concentrations of vanadium and molybdenum. (tr-auth)

10166 THE INFLUENCE OF TITANIUM, TUNGSTEN, AND ZIRCONIUM ON THE TENDENCY OF NICKEL–MOLYBDENUM ALLOYS TO INTERCRYSTALLINE CORROSION. Pavlov, S. S.; Svistunova, T. V. Metalloved. Term. Obrab. Metal., No. 11, 13-18(Nov. 1968). (In Russian).

Nickel-base alloys with 26.0 to 29.0% molybdenum were studied. The introduction of tungsten in these alloys in amounts from 3.5 to 5.3% eliminates the tendency to intercrystalline corrosion at high temperatures and lowers it at 600 to 800°C. (tr-auth)

10167 HIGH-TEMPERATURE CORROSION OF SOME GAS TURBINE ALLOYS. Viswanathan, R. (Westinghouse Research Labs., Pittsburgh). Corrosion, 24: 359-68(Nov. 1968).

Several high temperature alloys were evaluated for hot corrosion resistance at 1500°F using a controlled atmosphere combustion furnace burning high sulfur diesel fuel. Modification of commercial alloys and binary Ni–Cr and Co–Cr alloys were also studied using this facility. An overall analysis of corrosion data suggests that the optimum chromium content lies in the 20 to 80% range in binary alloys studied, and in commercial alloys somewhat lower chromium content can be tolerated. Significant improvements in corrosion resistance were achieved in the case of commercial alloy Udimet-700 by trace additions of lanthanum and yttrium. A high concentration of SO_3 in the gas stream and presence of sulfate deposits were conducive to accelerated rates of attack. (auth)

10168 INFLUENCE OF NICKEL, SILICON, AND MOLYBDENUM ON THE CORROSION OF "IRON–CHROMIUM–NICKEL" AUSTENITIC ALLOYS IN SUPERHEATED STEAM. Coriou, H.; Grall, L.; Mahieu, C.; Peiras, M.; Perez, A. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Mem. Sci. Rev. Met., 65: 643-50(Sept. 1968). (In France).

A study of the effects of nickel, silicon, and molybdenum concentrations on the corrosion behavior of chromium-iron-nickel austenitic alloys in water vapor at 600°C was undertaken. The alloy compositions which were most resistant to oxidation are described. (auth)

10169 ELECTRONIC INTERACTION BETWEEN METAL SURFACE ATOMS OF METALS AND ANIONIC COMPLEXES IN THE CORROSION OF FERROMAGNETIC AND PARAMAGNETIC NICKEL–MOLYBDENUM ALLOYS. Feller, Heinz Gerhard (Technische Univ., Berlin). Z. Metallk., 59: 952-7(Dec. 1968). (In German).

Potentiostatic and potentiodynamic polarization tests in various acids were carried out with and without external magnetic field on ferromagnetic and paramagnetic nickel alloys. The results lead to the conclusion that the anionic complexes react directly with the metal surface atoms by means of electronic interaction. Besides that, an indirect influence on the anodic dissolution is found which is due to the local variation in adsorption of the paramagnetic corrosion products at ferromagnetic alloys. (auth)

10170 NEW CORROSION-RESISTANT ZIRCONIUM–TANTALUM ALLOYS. Andreeva, V. V.; Chekhovskii, S. V.; Dontsov, S. N.; Moiseeva, I. S.; Klinov, I. Ya. Byull. Tekh.-Ekon. Inform., Gos. Nauch.-Issled. Inst. Nauch. Tekh. Inform., 20: No. 5, 14-16 (1967). (In Russian).

A series of corrosion-resistant zirconium–tantalum alloys were developed and, after testing, were introduced at several enterprises. Experimental alloys were melted from 99.7% pure zirconium and 99.25% pure tantalum in a tungsten-electrode arc furnace in a helium atmosphere, homogenized for 6 hr, forged at 1200 to 700°C, and subjected to corrosion tests in a sulfuric acid solution of different concentrations. It was found that with an increase in tantalum content, the corrosion rate decreased. At 20 to 80°C all the investigated alloys were resistant to sulfuric acid in concentrations below 75%. At 40°C, alloys containing 40% tantalum were resistant to 80% sulfuric acid concentration. Alloys containing 50 to 60 tantalum were resistant to 85% concentration at 40 to 120°C. Depending on the chemical composition and heat treatment conditions (800 to 1350°C for 2 hr), the alloys were found to have a tensile strength of 38 to 84 kg/mm^2, a yield strength of 33 to 88 kg/mm^2, an elongation of 13 to 29%, and a reduction of area of 56 to 75%. (ATD)

10171 THE INFLUENCE OF BERYLLIUM, CERIUM, VANADIUM, AND TITANIUM ON THE OXIDATION OF Nb–Mo–Cr ALLOYS. Adamova, A. S.; Tregubov, I. A. Izv. Akad. Nauk SSSR, Metal., No. 6, 206-11(Nov.-Dec. 1968). (In Russian).

The influence of Be, Ce, and Ti on heat-resisting Nb–2% Mo–2% Cr and Nb–3.75% Mo–1.25% Cr alloys at 500, 600, 700, 800, 900, and 1000°C in air was studied. The most effective alloying additions for increasing the thermal resistance of these ternary alloys were 3% V and 10% Ti, separately or together. Study of the penetration of oxygen in the samples during oxidation of the alloys indicated that additions of Ce, Be, V, and Ti had little effect on the penetration depth at 500°C. At 800°C, beryllium significantly decreased the depth of oxygen penetration, vanadium and titanium increased it, and cerium did not change it. (tr-auth)

10172 SOLUBILITY OF HYDROGEN IN TUNGSTEN AT HIGH TEMPERATURES AND PRESSURES. Mazaev, A. A.; Avarbe, R. G.; Vil'k, Yu. N. Izv. Akad. Nauk SSSR, Metal., No. 6, 223-6 (Nov.-Dec. 1968). (In Russian).

The reaction of tungsten with hydrogen was studied at 1773 to 3273°K and 1, 25, and 100 atm. The solubility of hydrogen in tungsten at constant pressure increased exponentially with increasing temperature. A proportional relation between hydrogen solubility and the square root of its pressure was established. The following equations were derived: $N_H = 6.61 \times 10^{-5} \exp(-10000/RT)\sqrt{P_{H_2}}$ up to 2700°K and $N_H = 1.1 \times 10^{-3} \exp(-40000/RT)\sqrt{P_{H_2}}$ above 2700°K. (tr-auth)

Preparation and Fabrication

Refer also to abstracts 9370, 9508, and 9617.

10173 (AWRE-O-52/68) ELECTRON METALLOGRAPHY OF URANIUM AND SOME URANIUM ALLOYS. Porter, I. T.; Ruckman, J. C. (Atomic Weapons Research Establishment, Aldermaston (England)). Sept. 1968. 19p. Dep. CFSTI. UK 4s. 6d.

The production of thin foils of uranium and some of its alloys by electro-polishing was investigated in order that the microstructural aspects of stress corrosion cracking of these materials might be studied by transmission electron microscopy. For good transmission electron microscopy the foil thickness was required to be less than 2000 Å. A literature survey revealed several investigations into the thinning of uranium, but little information on the thinning of the U–Mo and U–Nb–Zr alloys, which were of greatest interest. It was decided therefore to investigate the solutions used to thin uranium and, if possible, to apply these to the thinning of the alloys. (auth)

10174 (CONF-670506-3) A NEW PROCESS FOR URANIUM ALUMINIDE MANUFACTURE EMPLOYING FLUIDIZED BED TECHNIQUES. Grimmett, E. S.; Ballard, R. K.; Buckham, J. A. (Idaho Nuclear Corp., Idaho Falls). [nd]. Contract AT(10-1)-1230. 14p. Dep. CFSTI.

From 62nd National Meeting of the American Institute of Chemical Engineers, Salt Lake City, Utah.

By using fluidized-bed technology, uranium aluminide was produced in a four-step process from uranyl nitrate solutions and aluminum without requiring the costly intermediate production of uranium metal. Use of this process should reduce the overall costs for fuel cycles employing uranium aluminide, and the process appears adaptable to many other types of fuel cycles. (auth)

10175 (ORNL-tr-1828) PREPARATION OF URANIUM INGOTS FROM DOUBLE FLUORIDES. Le Boulbin, Emile (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'-Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report CEA-R-3248. 40p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 34863. (R.C.K.)

10176 URANIUM–PLUTONIUM ALLOY FUEL FABRICATION. Shuck, Arthur B. (Argonne National Lab., Ill.). Nucl. Met., Met. Soc. AIME, 13: 263-78 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The uranium–plutonium alloys have been used principally in zero-power and fast-reactor experiments where high density of fissile atoms, good thermal conductivity, and high thermal expansion are required. The binary uranium–plutonium alloys have very poor mechanical properties and oxidation resistance, except in low plutonium concentrations. Modifying elements, such as molybdenum, zirconium, or titanium, have been added to improve the mechanical properties. Approximately 11,000 kilograms of U–28.3 wt. % Pu–2.5 wt. % Mo alloy is being fabricated into 15,500 plate-type elements for the Zero Power Plutonium Reactor. The elements consist of rectangular plates of the fuel alloy in tight-fitting stainless steel jackets. Conventional hot-working methods of fabrication required temperatures in excess of 500°C to avoid billet cracking and a high-purity inert atmosphere to prevent oxidation. Vacuum melting and casting the U–28.3 wt. % Pu–2.5 wt. % Mo alloy into reusable, multiple-cavity molds was found to be a practical method for making rectangular-section bars from which the element plates were machined. Directional solidification of the castings from the bottom and continuous feeding of molten metal into the hot-topped molds was necessary to prevent internal shrinkages. The stainless steel jackets were stretch formed from welded-and-drawn, Type-304L tubing. The jackets were enclosed in a protective fixture and the cores were loaded through a funnel that prevented contact of the core with the jacket lip. Close-fitting end plugs were inserted in the jacket sleeves and forced tightly against the cores. The seal welds between the jacket sleeves and end plugs were made at less than one-half atmosphere pressure of inert gas. The reduced internal pressure prevented inflation of the fuel element at operating conditions. (auth)

10177 PLUTONIUM METALLIC AND CERAMIC FUEL FABRICATION AND DEVELOPMENT AT THE EUROPEAN INSTITUTE FOR TRANSURANIUM ELEMENTS. Mattys, H. M. (EURATOM, Karlsruhe, Ger.). Nucl. Met., Met. Soc. AIME, 13: 279-90 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Uranium–plutonium–iron alloy fuel rods have been produced for the critical experiment MASURCA by a centrifugal casting method. The total amount of plutonium contained in this loading was 175 kg. UO_2–PuO_2 pellets have been sintered for the fast reactor irradiation program. Dry powder blending was preferred to coprecipitation. No centerless grinding was necessary to obtain reproducible pellet diameter (5.40 mm ± 0.03 mm). The stoichiometry of the pellets was adjusted by sintering atmosphere control. Spherical particles of $PuO_{1.62}$ have been produced to be irradiated as graphite coated particles. (auth)

10178 METHOD AND APPARTUS FOR IMPROVING RECOVERY OF PLUTONIUM–GALLIUM ALLOYS BY ELECTROREFINING. Leary, Joseph A.; Mullins, Lawrence J. Jr.; Buchen, John F. (to United States Atomic Energy Commission). U. S. Patent 3,417,002. Dec. 17, 1968.

A device and method are given for recovering plutonium from plutonium–gallium alloys by an electrorefining process in which the alloy is the anode of the electrorefining cell. The E.M.F. of the cell reaction between the cathode and anode supplies the voltage to drive a control circuit. The method consists of adding iron, cobalt, or nickel to the anode in an amount equal to about 25 weight percent of the gallium present. (auth)

10179 PREPARATION OF COBALT–RARE-EARTH ALLOYS BY ELECTROLYSIS. Morrice, E.; Shedd, E. S.; Wong, M. M.; Henrie, T. A. (Reno Metallurgy Research Center, Nev.). J. Metals, 6: 34-7 (Jan. 1969).

High purity alloys of Co and rare earth metals were produced by electrodeposition of rare earth metal on a consumable Co cathode. These alloys, rich in rare-earth metals, are suitable for the preparation of Co–rare earth compounds with the addition of more Co by melting. The compounds can then be made into fine-particle permanent magnets by pulverization and consolidation. (auth)

10180 ELECTROWINNING OF BERYLLIUM. Wong, M. M. (Reno Metallurgy Research Center, Nev.); Couch, D. E.; O'Keefe, D. A. J. Metals, 6: 43-5 (Jan. 1969).

A method was developed in which beryllium metal was electrowon from BeO in a 60 mole % LiF-40 mole % BeF_2 electrolyte at an applied voltage of 2.6 V at 700°C. After electrolysis, the metal product and salt were briefly heated at 1300°C to coalesce the beryllium into spheres, then cooled to 900°C and poured through a stainless steel screen for recovery of the metal. The principal problem in the electrolysis is the limited solubility of BeO, which tends to restrict the current that can be passed through the cell at a given voltage. Experimental work indicated that increased anode area and proximity of BeO to the anode would alleviate this problem. (auth)

10181 VANADIUM-BASED ALLOYS. (to Gesellschaft fuer Kernforschung mbH). British Patent 1,137,242. Dec. 18, 1968. Priority date Aug. 6, 1966, Germany.

A vanadium-based alloy containing niobium and titanium is described for use in reactor structural material or cladding material for fuel elements to be utilized at 500 to 800°C. Stress-rupture curves are given of alloys containing less than 3% titanium of V–20% Nb–Ti and V–15% Nb–Ti. Stress-rupture data are shown for alloys containing 2.8 and 5% titanium. (J.C.W.)

10182 BERYLLIUM–ALUMINIUM–MAGNESIUM COMPOSITE. (to Mallory Metallurgical Products Ltd.). British Patent 1,134,594. Nov. 27, 1968. Priority date May 13, 1966, United States.

A method for preparing beryllium-aluminum-magnesium alloys by liquid phase sintering is described. Powdered Be is mixed with powdered Al–Mg, pressed in a die to form a green compact which is sintered. An additive powder is added to eliminate expulsion of the melt from the Be specimen by lowering the surface energy of the liquid metal in relation to the beryllium oxide film. The liquid metal progressively dissolves the solid metal. The additive powder is selected from alkali metal and alkaline earth metal halides. (F.S.)

10183 BERYLLIUM–ALUMINIUM–SILVER COMPOSITE. (to Mallory Metallurgical Products Ltd.). British Patent 1,134,603. Nov. 27, 1968. Priority date Apr. 21, 1966, United States.

A method for preparing composites of Be with an alloy of Ag–Al by liquid phase sintering is described. Powders of Be and powders of Ag–Al alloy are mixed and pressed in a die to form a green compact which is sintered. Lithium fluoride and lithium chloride are added to confine the alloy within the Be, to prevent expulsion of the alloy from the sintered compact by breaking down the oxide film on the Be and/or by migrating to the metal oxide interface to lower the surface energy of the liquid metal in relation to the BeO film so that the liquid metal dissolves the solid metal. (F.S.)

10184 ROLLING TUNGSTEN-ALLOY SHEET AND FOIL. Korneev, N. I.; Kuzina, T. S.; Gavrilyuk, M. I.; Kalugin, V. F.; Starkov, V. N.; Tyukalov, G. V. Byull. Tekh.-Ekon. Inform., Gos. Nauch.-Issled. Inst. Nauch. Tekh. Inform., 20: No. 5, 8-9 (1967). (In Russian).

A method of rolling 99.96%-pure tungsten alloy sheets and foil was developed. As-cast alloy ingots do not withstand rolling because of their coarse-grained structure and must be first extruded and then rolled. After extrusion, the alloy has a sufficient ductility. It can be rolled at temperatures as low as 1000°C with 60% reduction. Extruded sheet bars, vacuum annealed at 1800°C for 1 hr and rolled with process annealing to a thickness of 6 to 6.5 mm at 1400 to 1450°C, are conditioned by machining, process annealed at the same temperature for 2 to 3 min, and rolled to a thickness of 1.95 mm in six passes, with reheating to 1200 to 1250°C in a hydrogen furnace after each pass. Pack rolling with process annealing and without envelopes is used. Sheets 0.2 to 0.1 mm thick can be cold-rolled with 70 to 78% reduction into foil 40 mm wide and 400 mm long. The tensile strength of this foil is 203 to 222 kg/cm/mm^2, i.e., 40 to 55 kg/cm/mm^2 higher than that of sintered tungsten foil. This rolling method yields metal with a fine fibrous structure and an NDT temperature of –20°C. (ATD)

Properties Evaluations

Refer also to abstracts 9395, 9666, 10701, 10716, 11232, 11235, and 11279.

10185 (CEA-CONF-1054) URANIUM AND OXYGEN SELF-DIFFUSION IN UO_2. Marin, J. F.; Contamin, P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1968]. 36p. (MET-16/68; CONF-680825-2). Dep.

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y.

Uranium self-diffusion coefficients in hyperstoichiometric uranium dioxide UO_{2+x} ($0.005 \leq x \leq 0.217$) were determined in the temperature range 1275° to 1650°C by means of the alpha spectrum degradation method. The results can be fitted, in the composition range $0.03 < x < 0.20$, with the Arrhenius equation: $D = 0.13\,x^2\,[1 + 10^3x^3]\exp(-85{,}000/RT)$. Oxygen self-diffusion in massive UO_2 samples has been studied by means of mass spectrometry spark or laser source analysis, $^{16}O\,(p,\alpha)^{15}N$ reaction, and ionic mass analyzer. In the temperature range 780° to 1250°C, oxygen diffusion in stoichiometric samples can be represented by the equation: $D = 0.26\exp(-59{,}300/RT)$. A considerable enhancement of D with small stoichiometry deviations has been evidenced at 800°C. (auth)

10186 (CEA-R-3573) DIFFUSION AND KIRKENDALL EFFECT IN PLUTONIUM-ZIRCONIUM SYSTEM. Remy, Clotilde (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Oct. 1968. 116p. (In French). Dep.

Results are reported for the diffusion of Pu in the $\epsilon\beta$ phase (bcc) over the range 10 to 70 at. % Pu. Concentration-penetration curves, obtained by using electron microprobe, were analyzed. Chemical diffusion coefficients, measured from 650 to 900°C, increase with plutonium concentration and follow the Arrhenius law. Activation energies range from 18,000 up to 44,000 cal/mole for plutonium concentrations from 60 to 20 at. % Pu. The Kirkendall effect was observed by the shift of inert markers located originally at the Zr–PuZr interface. Analysis of intrinsic diffusion coefficients of the two species and the lattice velocity was carried out by the incremental couples technique using Darken and Heumann equations. It was found that $D_{Pu} > D_{Zr}$; the ratio D_{Pu}/D_{Zr} increases from 1 to 6 over the range 15 to 60 at. % Pu. Activation energies for intrinsic diffusion coefficients vary between 25 and 50 Kcal/mole. (tr-auth)

10187 (GEMP-643) THERMOPHYSICAL PROPERTIES OF LOW CARBON 304 STAINLESS STEEL TO 1350 C. Feith, A. D.; Hein, R. A.; Johnstone, C. P.; Flagella, P. N. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). [1968]. Contract AT(40-1)-2847. 14p. (CONF-681009-3). Dep. CFSTI.

From 8th Annual Conference of Thermal Conductivity, Lafayette, Ind.

Thermal conductivity, electrical resistivity, enthalpy, and thermal diffusivity data for AISI 304L stainless steel are presented for the temperature range from 300 to 1350°C. The electrical resistivity, ρ, in Ωm, was measured from room temperature to 1400°C; it followed the relationship: $\rho = 7.01 \times 10^{-7} + 9.295 \times 10^{-10}T - 5.479 \times 10^{-13}T^2 + 1.44 \times 10^{-16}T^3$. Thermal conductivity was found to increase linearly with temperature from 19.6 $Wm^{-1}C^{-1}$ at 300°C to approximately 34.0 $Wm^{-1}C^{-1}$ at 1350°C. Measurements from 520 to 1350°C were obtained in a high-temperature, radial heat flow apparatus which has a precision of about ±6 to 8% in this range. The lower temperature values (from 300°C) were determined by measuring the thermal diffusivity and enthalpy of specimens fabricated from the same raw material which was used for the thermal conductivity measurements. Typical values of thermal diffusivity for this material are $4.4 \times 10^{-6}m^2s^{-1}$ at 300°C, $5.4 \times 10^{-6}m^2s^{-1}$ at 700°C, and $6.0 \times 10^{-6}m^2s^{-1}$ at 1100°C. Correlation of the thermal conductivity data with electrical resistivity data is discussed. Enthalpy data were obtained using a drop technique and were found to obey the relationship $H_T - H_{25} = 0.5153 \times 10^3T + 6.262 \times 10^{-2}T^2 - 18.431 \times 10^3$ in the 200 to 1350°C range. The specific heat capacity based on this equation is: $c_p = 0.5153 \times 10^3 + 12.524 \times 10^{-2}T$, where T is in C, H in Jkg^{-1}, and c_p is in $Jkg^{-1}C^{-1}$. (auth)

10188 (LA-4003) COMPILATION OF CALCULATED DATA USEFUL IN PREDICTING METALLURGICAL BEHAVIOR OF THE ELEMENTS IN BINARY ALLOY SYSTEMS. Teatum, E. T.; Gschneidner, K. A. Jr.; Waber, J. T. (Los Alamos Scientific Lab., N. Mex.). Aug. 29, 1968. Contract W-7405-eng-36. 206p. (LA-2345). Dep. CFSTI.

Physicometallurgical data have been computed for all the binary combinations of elements in the periodic table with the exception of the halogens, rare gases, and those elements having atomic numbers higher than that of americium. Brief descriptions are given of the formulae for the following quantities: the radius ratio, the sublimation energy ratio, the Mott bonding number, the Hildebrand or heat of mixing factor, and the electronegativity difference. Some possible uses of these quantities are also described. The sources of data selected for the calculations and the arrangement of the tables are discussed. (auth)

10189 (NLCO-1009) ELEVATED-TEMPERATURE MECHANICAL PROPERTIES OF URANIUM WITH VARIOUS PROCESSING HISTORIES. Wexlin, L. G. (National Lead Co. of Ohio, Cincinnati). Dec. 1968. Contract AT(30-1)-1156. 30p. Dep. CFSTI.

Specimens for mechanical testing were prepared from standard production uranium in the cast, extruded, and rolled conditions. Some of the metal of each type was beta heat treated. The mechanical properties investigated were: tensile, tensile impact, drop hammer, hardness, and compression. The tests were conducted at temperatures ranging from 885 to 1235°F. A few tests were made at higher temperatures. (auth)

10190 (ORNL-RMIC-9) BIBLIOGRAPHY OF SECOND AND THIRD ORDER ELASTIC CONSTANTS. Pomerance, Herbert (Oak Ridge National Lab., Tenn.). Dec. 1968. Contract W-7405-eng-26. 27p. Dep. CFSTI.

A bibliography of 196 references is presented on second and third order elastic constants of monocrystalline materials compiled from Physics Abstracts and the files of the Research Materials Information Center literature since 1964. The materials are arranged alphabetically by chemical symbol. Included with the symbols are the crystalline form where it is not cubic, temperature and pressure ranges of the measurements, the alloying percentages, and the reference number. (F.S.)

10191 (RPI-3719-3) FRACTOGRAPHIC STUDY OF PRECIPITATION HARDENED AND DISPERSION STRENGTHENED MAGNESIUM-BASE ALLOYS. Calhoun, C. D.; Stoloff, N. S. (Rensselaer Polytechnic Inst., Troy, N. Y.). June 1, 1968. Contract AT(30-1)-3719. 36p. (CONF-680604-11). Dep. CFSTI.

From Symposium on Radiation Effects to Reactor Metals, San Francisco, Calif.

The fracture characteristics of Mg-3.7Th-0.4Zr and of Mg-0.6Zr were investigated. The ternary is a precipitation hardenable system exhibiting a coherent transition precipitate while the binary forms a stable dispersion of Zr hydride when heated in an atmosphere of hydrogen. The ternary was investigated in four heat treated conditions which provided two levels of yield stress. A solution treated alloy and an overaged alloy provided one yield stress, while the other yield stress level was attained by interrupting the heat treatment prior to optimum aging and by slightly overaging. It was not possible to obtain the same yield stress level with different heat treatment for the binary which was examined in the hydrided and solution treated conditions. Specimens were fractured at −196, 23, and 210°C by tensile testing at a strain rate of 1.4×10^{-2}/min. Further information concerning the influence of twins and the initiation of microvoids was acquired by differential temperature tests, where specimens were deformed at one temperature to a predetermined strain followed by deformation to fracture at another temperature. The temperatures involved in the differential temperature tests were the same as those referred to previously. Two stage replication of the fracture surface and subsequent examination with the electron microscope were accomplished on all fractured specimens in order to determine the mode of failure, the influence of precipitate and hydride dispersion on the size and distribution of dimples, and the amount of serpentine glide as a function of temperature and specimen condition. The propensity for twinning and the initiation and degree of porosity were determined as a function of temperature, microstructure, and strain by polishing tensile specimens to their longitudinal centerline and examining the microstructure by light microscopy. Also, metallography adjacent to the fracture surface aided in revealing the mode of failure. (auth)

10192 PLUTONIUM RECYCLE IN U. S. THERMAL REACTORS. Beekman, Myron C.; Wagner, Harvey A. (Detroit Edison Co.). Nucl. Met., Met. Soc. AIME, 13: 6-16 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

It is estimated that 100,000 kilograms of fissile plutonium will have been recovered from the generation of light water reactors by the end of year 1980. The use of this material and the quantities available for research and development programs, as a fuel material for fast breeder reactors and for recycling in thermal reactors, are discussed. Two reactor manufacturers are evaluating the economics and technical parameters of recycling plutonium in commercial water reactors. An analysis of future plutonium values has been made with respect to the cost of ^{235}U. (auth)

10193 YIELDING AND FRACTURE IN TUNGSTEN AND TUNGSTEN–RHENIUM ALLOYS. Raffo, P. L. (Lewis Research Center, Cleveland). J. Less-Common Metals, 17: 133-49(Feb. 1969).

A study was made of the mechanical properties of vacuum arc-melted tungsten and tungsten–rhenium alloys at 77 to 810°K in order to elucidate the mechanism by which rhenium additions lower the ductile–brittle transition temperature of tungsten. The temperature and strain rate dependency of the yield stress of tungsten are reduced by alloying with rehnium, inferring a reduction in the Peierls stress. The reduction in the transition temperature is attributed to the reduced Peierls stress through its effect on the mobility and rate of multiplication of dislocations. (auth)

10194 THE PROPERTIES OF SOLID SOLUTION, MOLYBDENUM-RICH, MOLYBDENUM–RHENIUM ALLOYS FROM -190°C TO 400°C. PART I. ELASTIC PROPERTIES. PART II. PLASTIC PROPERTIES. Davidson, David Lee. Houston, Tex., Rice Univ., 1968. 169p.

Thesis.

The adiabatic elastic constants of molybdenum and nominally 8, 15, and 25 atomic percent rhenium alloys were measured by the pulse superposition method. The results at 25°C are summarized. Based on calculations using the elastic constants in a central force model, rhenium additions strengthen nearest-neighbor interactions, but weaken second-nearest neighbor interactions. These trends are thought to be due to changes in the anisotropic interaction of the d electrons. The bulk modulus of the high rhenium alloy is particularly temperature sensitive, partly because of the effects of the electron-gas contribution. Debye temperatures calculated from the elastic constants are in good agreement with those measured by calorimetry. Thermal expansion of molybdenum and its alloys was found to be essentially the same, in this temperature range. The plastic properties of molybdenum and the 8, 15, and 25 atomic percent (nominal) single crystals of axial orientation [112] and [110] were tested in simple shear in the [111] direction at intervals in the temperature range 78 to 425°K. Shear stress-shear strain, activation volume, and temperature change tests were made. No major differences were found between the two orientations. Whereas the molybdenum exhibits a parabolic stress-strain curve at 300°K and below, alloying causes the appearance of a three-stage hardening curve, as seen for molybdenum at 350°K and above. Rhenium additions cause a minimum in flow stress at about 8 at. % for temperatures below 300°K, an effect similar to that reported for rhenium additions to tantalum. Flow stress increase due to solute addition became a linear function of concentration at 350°K and above. Lattice frictional (Peierls–Nabarro) stress was calculated using the measured anisotropic elastic constants. Alloying rhenium with molybdenum is found to reduce the magnitude of the (110)[111] and (112)[111] Peierls stress for both edge and screw dislocations. In contrast, similar calculations using published elastic constants of tantalum–rhenium alloys indicate the Peierls stress increases with rhenium additions. Estimates of the stacking fault energy from variations in the elastic constants indicate that rhenium additions to molybdenum decrease the SFE, while the SFE for tantalum–rhenium is increased. The twinning shear coefficient decreases with rhenium additions to molybdenum. Twinning is observed in the 25 at. % alloys at 300°K and below. A qualitative explanation of the observed plastic behavior is proposed, based on all the available information to date. (Diss. Abstr.)

10195 CENTRAL STATION FAST REACTOR FUEL REQUIREMENTS: BELGIAN EXPERIENCE. Van Dievoet, J.; Vanden Bemden, E. (BelgoNucleaire, S.A., Brussels). Nucl. Met., Met. Soc. AIME, 13: 17-27(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The research and development program for the design and the construction of fast reactor prototypes in cooperation with Germany and the Netherlands and the Belgian industrial nuclear power program is discussed. Considerations about plutonium availabilities and plutonium needs are given. Uncertainties affecting the establishment of an estimation of future plutonium production and plutonium needs include the necessity to envisage the use of a possible excess of plutonium in thermal reactors and the interest to study a uranium-235 enrichment of the fast reactors in case of a temporary lack of plutonium. (auth)

10196 CENTRAL STATION BREEDER REACTORS: PLUTONIUM FUEL REQUIREMENTS. UNITED KINGDOM EXPERIENCE. Frost, B. R. T. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Met., Met. Soc. AIME, 13: 85-95 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The United Kingdom program for the installation of nuclear power stations envisages that the first commercial fast breeder station will start operation between 1976 and 1978. Since the 250 MWe prototype fast reactor (P.F.R.) is scheduled to reach full power in 1971 the fuel pin and sub-assembly designs for the first central stations must follow that of the P.F.R. quite closely. The core parameters of the P.F.R. and a published 1000 MWe design are compared; it is shown that the only essential difference is the larger number of sub-assemblies in the latter and hence a lower length: diameter ratio for the core. The key materials problems which need to be studied to improve fast reactor economics and safety are discussed. (auth)

10197 CENTRAL STATION FAST BREEDER REACTOR PLUTONIUM FUEL REQUIREMENTS: U. S. EXPERIENCE. Wright, J. H. (Westinghouse Electric Corp., Pittsburgh). Nucl. Met., Met. Soc. AIME, 13: 58-79(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The near term use for plutonium in fast breeder power plants is expected to be quite modest from now until the mid 1980's, two or three tons per year covering the foreseeable situation. Plutonium requirements for the anticipated fast growing breeder capacity in the late 1980's may exceed the supply from all sources on an annual basis but a modest holding time could cover the possible shortage without undue economic penalty. The amount of plutonium required as initial inventory and produced annually by the fast breeder is a function of the breeder design parameters of which specific power and breeder ratio are most significant. Economic and performance objectives stress the desirability of a high performance ceramic fuel for breeder reactors. (auth)

10198 PLUTONIUM: THEN AND NOW. Baker, R. D. (Los Alamos Scientific Lab., N. Mex.). Nucl. Met., Met. Soc. AIME, 13: 1-5(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The technical highlights in the first years of plutonium after its discovery in 1941 are reviewed. Discovery, a method for its production, much of its chemistry worked out on the tracer scale, the development of micrometallurgy and then the large scale production, separation, purification, and reduction to metal are included. Progress on plutonium research is reported. (J.C.W.)

10199 MEASUREMENTS OF YOUNG'S MODULUS OF POLYCRYSTALLINE NICKEL–TUNGSTEN ALLOYS AT ELEVATED TEMPERATURES. Harrigan, William C.; Nix, William D. (Stanford Univ., Calif.). Trans. Met. Soc. AIME, 242: 2491-4 (Dec. 1968).

Dynamic measurements of Young's modulus have been made for polycrystalline Ni–W alloys from room temperature to 800°C. The alloys studied range in composition from pure nickel to Ni-10 at. % W. The results indicate that Young's modulus decreases linearly with temperature above the Curie temperature. The rate of change of Young's modulus with temperature was found to range from 10^4 psi per °C for pure nickel to 0.82×10^4 psi per °C for Ni-10% W. At all temperatures the elastic modulus decreases with increasing tungsten content up to 1 at. % W, and increases as the tungsten content is increased above that level. Young's modulus decreases slightly as the carbon content is increased from 0.002 to 0.09 wt % C. (auth)

10200 NEW CREEP MACHINE FOR TESTING WITH HIGH GAIN UNDER HIGH VACUUM; ITS USES IN THE STUDY OF URANIUM AND U–1.1 WT. PERCENT Mo ALLOYS. Collot, J.; Cizeron, G. (Ecole des Mines, Paris). Mem. Sci. Rev. Met., 65: 549-65(July-Aug. 1968). (In French).

A creep machine by which the elongations can be measured under vacuum or controlled atmosphere conditions on the basis of a differential extensometric system with displacement pickup is described. Continuous recording of the information is featured. Mo–U alloy is studied for creep behavior utilizing the new instrument. (J.C.W.)

10201 ANALYSIS OF CREEP CURVES FOR A MAGNESIUM–ZIRCONIUM ALLOY. Woodford, D. A. (General Electric Co., Schenectady, N. Y.). J. Inst. Metals, 96: 371-74(Dec. 1968).

An analysis used previously to interpret the increasing creep rate in constant-load tests was applied to data for a Mg–Zr alloy. It is shown that an equation of the form $\epsilon = (At + B)^{1/1-n} - 1$, where ϵ is the nominal strain, t the time, and A, B, and n are dependent on the test conditions, provides a good fit to experimental measurements over a major part of the creep curve. This equation is applicable to all the results examined for a range of test conditions. The physical significance of the parameter n is considered in terms of the strain-rate-sensitivity of plastic deformation. A dependence of this parameter on grain size, and a

correlation with the elongation at rupture are demonstrated. (auth) (UK)

10202 SOLUBILITY OF NITROGEN IN LIQUID NICKEL AND IN NICKEL–CHROMIUM, NICKEL–MOLYBDENUM, AND NICKEL–TUNGSTEN MELTS. Fedorchenko, V. I.; Averin, V. V.; Samarin, A. M. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR, 183: 894-6(Dec. 1, 1968). (In Russian).

Studies were made of nitrogen solubility in melted nickel at 1500, 1600, and 1700°C and pressures from 250 to 760 mm Hg; in nickel–chromium melts containing 21.8 wt % Cr at 1600°C and 140 to 760 mm Hg pressures; in nickel–molybdenum melts containing 3.6, 8.9, 17.0, and 31.6 wt % Mo at 1600°C; and in nickel–tungsten melts with 6.7, 15.7, 30.0, 38.5, and 51.4 wt % W. Data obtained showed that Cr, Mo, and W increase nitrogen solubility in nickel. (R.V.J.)

10203 RARE EARTH IMPURITIES IN LIQUID ALUMINIUM. Stupian, G. W.; Flynn, C. P. (Univ. of Illinois, Urbana). Phil. Mag., 17: 295-326(Feb. 1968). (COO–1198–457).

The magnetic susceptibility and solvent Knight shift changes caused by the rare earth series of elements dissolved in liquid aluminum have been measured for solute concentrations less than 2 at. %. Except for the cases of Eu and Yb, the impurity susceptibility conforms quite closely to the theoretical predictions obtained from the theory of Van Vleck for trivalent ions. Eu and Yb are best approximated by divalent ion core states. The observed Knight shifts were interpreted using partial wave scattering theory. Phase shifts describing the screening due to different core orbitals are tested as independent. Since the susceptibility is in close agreement with spin–orbit coupling theory for free ions, one must regard the orbitals as completely occupied or unoccupied. The different orbitals are associated with phase shifts of π or 0 at the Fermi surface in the respective cases. Very good agreement between theory and experiment is achieved when the core states are taken to be about 0.5 eV wide and the splitting between the spin sub-bands in heavier elements is about 1 eV. The results are not consistent with perturbation theory predictions of the Ruderman–Kittel–Yosida type, and an alternative form of spin polarization near magnetic impurities is presented. (auth)

10204 EFFECT OF TEMPERATURE ON PRESTRESSING WIRES. Bate, S. C. C.; Corson, R. H. (Building Research Station, Watford, Eng.). pp 237-40 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The behavior of wires is examined in relation to the functional requirements for tendons in prestressed concrete vessels. Data, including new data, on the relaxation of stress in cold-drawn wire in the temperature range from 28°C to 120°C are considered with information on behavior at higher temperatures. (auth) (UK)

10205 LONG-TERM RELAXATION BEHAVIOUR OF STABILIZED PRESTRESSING WIRES AND STRANDS. Cahill, T. (Somerset Wire Co., Ltd., Cardiff, Eng.); Branch, G. D. pp 219-28 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

In the design of pressure vessels for nuclear power stations a very important criterion is the total of expected relaxation losses over the life of the vessel. These losses are the sum of several factors, including shrinkage of concrete, creep of concrete, and relaxation of the prestressing tendons. In the case of the prestressing tendons, the elevated temperatures at which the vessels operate can more than double the relaxation losses, and it becomes even more important to have an accurate estimate of the probable losses over a 30 year period. Some progress has already been made towards the reduction of relaxation losses by the use of stabilized wire and strand; a material that relaxes by only one-fifth of the amount of conventionally treated wire and strand was used in the construction of Wylfa nuclear power station. The work carried out in analyzing the available data, including relaxation tests up to 30,000 h duration, on stabilized wire and strand, is described. Several established methods of extrapolation were applied to the data in order to provide estimates for the likely behavior over periods of up to 30 years. It was concluded that the best estimates can be made by using a new method of extrapolation based on the established relationship between log(strain rate) and log(time). The use of this new method enabled the accurate prediction of relaxation losses of stabilized materials at temperatures up to 100°C. (auth) (UK)

10206 STUDY ON THE STAINLESS STEELS FOR FAST REACTOR. 1. ON THE DEFORMATION RESISTANCES AND THE TENSILE STRENGTHS OF AUSTENITIC STEELS OF 304 AND 316 SERIES WITH DIFFERENT CARBON CONCENTRATIONS. Yoda, Renpei; Yoshida, Heitaro Tetsu To Hagane, 54: 288 (Aug. 1968). (In Japanese).

The sheath tubes of nuclear fuel used for fast reactors are required to have high strength at high temperature and good workability, therefore, austenitic steels are used. As the transfer of carbon takes place between the sheath tubes and carbide fuels or sodium, the effects of carbon on types 304 and 316 austenitic steels were investigated. The solid solute amount of carbon, the grain size of crystals, hardness and the lattice constants were investigated in relation to the dissolving temperature. The temperature of 1150°C was selected for the tests. In order to study the effects of carbon content on the workability, the deformation resistance was determined. The deformation resistance increased proportionally to the carbon content, and the effect of the residual carbide was not recognized. The tensile strength at high temperature increased proportionally to the carbon content. The phenomenon of catastrophic oxidation appeared in type 316 steels of 0.006 to 0.21% carbon, but was not observed in materials of high carbon content. (NSA of Japan)

10207 LIQUID SODIUM: CHEMICAL AND PHYSICAL PROPERTIES AND ITS USE IN NUCLEAR ENGINEERING (1962–1967). Library Bibliography No. 128. Whetstone, Eng., English Electric Company, 1968. 98p. 33s.

The bibliography contains 872 references arranged under the following headings: other bibliographies; miscellaneous and general reports; chemical and physical properties of sodium, including technology; analysis of sodium; purification; properties of materials in liquid sodium, including corrosion and mass transfer; liquid metal cooled reactors; use of liquid sodium as reactor coolant (heat transfer, boiling, void coefficient, reactivity); cooling circuits (heat exchangers, steam generators, test loop installations, pumps, flow meters, leakage); and sodium fires and safety. (UK)

10208 PLASTIC DEFORMATION BY FRICTION OF SOME METALLIC MONOCRYSTALS WITH HEXAGONAL STRUCTURE: BERYLLIUM, COBALT, AND ZINC. Barquins, Michel; Andarelli, Genevieve; Courtel, Robert (Centre Technique d'Analyse des Surfaces de frottement, Bellevue, France). Compt. Rend., Ser. A and B, 267: 664-7(Oct. 28, 1968). (In French).

The experimental results relative to the plastic deformation of crystals of Be, Co, and Zn, under the effects of a sapphire hemispheric rubbing contact, are described. In each case, it was necessary to determine the importance of each of the various deformation modes and that which predominates in the formation of the frontal rim. (tr-auth)

10209 EFFECT OF TEMPERATURE ON THE MECHANICAL PROPERTIES AND FORMABILITY OF SINTERED MOLYBDENUM. Bogoyavlenskii, K. N.; Ris, V. V. Tr. Leningrad. Politekh. Inst., No. 271: 9-15(1966). (In Russian).

Sintered molybdenum, 99.9% pure, was hot-rolled, warm-rolled, or cold-rolled into sheets with a thickness of 2.0 to 3.0, 1.0 and 0.2 to 0.4 mm, respectively. The sheets were vacuum annealed at 800 to 1250°C and tested for mechanical properties at 20 to 800°C and for formability at 20 to 500°C. Cold-rolled and hot-rolled sheets were ductile at room temperature, while hot-rolled sheets were brittle both in the as-cast and in the annealed condition. Regardless of the thickness, the sheet strength decreased and the elongation increased not only with increasing annealing temperature but also with increasing angle (from zero to 90°) between the direction of the cut and the direction of rolling. With increasing test temperature, the molybdenum tensile strength, yield strength and elongation changed in a similar pattern with a partially sharp increase in elongation of the specimens cut in the direction transverse to that of the rolling. Warm- and cold-rolled molybdenum sheets in the as-rolled condition, or annealed at below the recrystallization temperatures had a satisfactory ductility at room temperature which increased only slightly with heating to 500 to 600°C This eliminated the necessity of preheating in forming cold-rolled molybdenum at room temperature. After recrystallization annealing, the sheets exhibited brittleness along certain directions, but became ductile again with subsequent heating to 100 to 200°C. The formability of hot-rolled molybdenum sheets, which are brittle at room temperature, was greatly improved by preheating the blanks to 300 to 400°C, which made it possible to form parts with a minimum relative bend radius of 0.25 (r/s, where s is the sheet thickness). (ATD)

10210 MECHANICAL PROPERTIES OF SINTERED NIOBIUM SHEETS. Bogoyavlenskii, K. N.; Ris, V. V. (Leningrad Polytechnic Inst.). Tr. Leningrad. Politekh. Inst., No. 271: 5-8(1966). (In Russian).

The properties of niobium sheets were investigated. Sintered niobium bars 22 × 22 mm were forged to 5-mm-thick sheet bars with process annealing (in vacuum at 2000°C for 30 min). The sheets bars, after annealing, were cold rolled with 60 to 97% reduction to sheets 0.15 to 2.00 mm thick, which were then annealed at 800 to 1250°C. It was found that with decreasing sheet thickness (increased reductions in cold rolling) of as-cold worked sheets, the tensile strength increased and elongation decreased in both as-rolled and annealed sheets. For instance, as-rolled sheets 2 and 0.15 mm thick had a respective tensile strength of 49 to 56 kg/mm^2 and 78 to 100 kg/mm^2 and an elongation of 6.8 to 7.2% and 2.5 to 5.0%. The same sheets after annealing at 1250°C had a tensile strength of 34 to 35 kg/mm^2 and 53 to 55 kg/mm^2, and an elongation of 19 to 20% and 16 to 25%. Annealing at 800 to 900°C, which removes residual stresses, improved to some extent the ductility while lowering the strength very little. In the Ericsen test, the depth of indentation varied from 3 mm for 0.15 mm thick sheets to 9.5 mm for 2 mm thick sheets. A sharply pronounced anisotropy of mechanical properties, especially ductility, was observed in both as-worked and annealed sheets, which should be taken into consideration in developing the methods of niobium sheet processing. (ATD)

10211 INFLUENCE OF A SECOND PHASE ON THE YIELDING CHARACTERISTICS OF ZIRCONIUM. Edmonds, D. V.; Beevers, C. J. (Univ. of Birmingham, Eng.). Met. Sci. J., 2: 228-32 (Nov. 1968).

Tensile tests were carried out to investigate the yielding characteristics of two-phase Zr–H_2 alloys. The tests were performed at room temperature at a strain rate of 3.75×10^{-4} sec^{-1}. Discontinuous yielding was observed at fine grain sizes (<0.006 mm grain dia) in pure Zr, and for the same grain size the upper yield stress and the magnitude of the yield drop were larger in transverse than in longitudinal specimens. The addition of H_2 (0 to 210 ppM) to form zirconium hydride precipitates affected the discontinuous yielding behavior of fine-grained specimens. Increasing the H_2 content increased the precipitate size and progressively decreased the upper yield stress, eventually resulting in complete elimination of a yield drop or yield inflection. Air-cooling rather than furnace-cooling specimens from the hydriding temperature increased the number of precipitates and was also more effective in removing abrupt yield. The role of the zirconium hydride precipitates in the yielding process was considered in terms of their ability to act as preferential nucleation centers for pre-yield plastic regions. (auth)

10212 ISOTHERMAL COMPRESSIBILITY OF THE LIQUID ALKALI METALS. Pasternak, Alan D. (Univ. of California, Livermore). Mater. Sci. Eng., 3: 65-70(1968-69). (UCRL-70900).

A corresponding-states correlation, based on the radial distribution function, is established which describes the temperature dependence of the isothermal compressibilities of liquid sodium, potassium, rubidium and cesium. It is shown that if the liquid alkali metals follow the same form of a two-parameter intermolecular potential energy function, then a simple relationship should exist between reduced compressibility and reduced temperature. Independently determined parameters are used to define the reduced quantities and to establish the relationship. The correlation can be used to predict the compressibility of lithium (for which no data are presently available) and to extend the data for rubidium and cesium to temperatures above the experimental range. (auth)

10213 THE EVALUATION OF DATA OBTAINED WITH DIFFUSION COUPLES OF BINARY SINGLE-PHASE AND MULTIPHASE SYSTEMS. Wagner, C. (Max-Planck-Institut fuer Physikalische Chemie, Goettingen, Ger.). Acta Met., 17: 99-107 (Feb. 1969).

Data obtained with diffusion couples of binary systems can be evaluated most conveniently with the help of equations by Sauer and Freise in order to calculate the interdiffusion coefficient D as a function of composition. A simplified derivation of the principal equation for the calculation of D as a function of mol fraction N_2 is presented. In multiphase systems with intermediate compounds which have a narrow homogeneity range, one may calculate values of the integral $\int D dN_2$ extended over the homogeniety range of the various compounds. It is shown how values of these integrals are related to the parabolic rate constants for the growth of compound layers in diffusion couples under various conditions and, furthermore, to the thickness of compound layers which are formed under steady-state conditions, e.g., when iron is subject to dissolution in a well-stirred bath of liquid zinc, or when metal oxides are formed by oxidation of a metal and volatilize at a constant rate into a stream of oxygen passed over the sample. (auth)

10214 STUDY ON STEEL TUBES FOR STEAM GENERATOR OF FAST BREEDER REACTOR. Yamamoto, Shunji; Onishi, Tadatoshi (Kobe Steel Works, Ltd., Japan). Tetsu To Hagane, 54: 284(Aug. 1968). (In Japanese).

In the fast breeder reactor, austenitic stainless steel is used for the liquid sodium cooling circuit, but in the water-steam system, it is advantageous to use ferrite steel. When stainless steel and ferrite steel exist together in a sodium loop, transfer of carbon takes place, and the consequent strengths of steels are problematical. To develop a ferrite steel, which has high strength at high temperature without carbon transfer; the characteristics after heat treatment, strength at high temperature, and the carbon transfer of 2¼ Cr–1 Mo steel with Nb, Ti or W additions, were investigated. Heat treatment for 9 steels were studied. Tensile tests and creep fracture tests were carried out at 550°C. Each sample was explosively joined with 18–8 Mo steel, heated at 600 to 700°C for 24 to 250 hours. The change of carbon content in the ferrite steel was measured. The steel with 1 to 1.5% Nb addition was remarkably improved in its creep fracture strength, and the decarbonized layer was not observed on the ferrite steel side. This steel was the most satisfactory material for the steel tubes of the steam generator for the fast breeder reactor. (NSA of Japan)

10215 MECHANICAL BEHAVIOR OF POLYCRYSTALLINE TUNGSTEN AT ELEVATED TEMPERATURE. Robinson, S. L.; Sherby, O. D. (Stanford Univ., Calif.). Acta Met., 17: 109-25(Feb. 1969).

The influence of stress, temperature, grain size and subgrain size on the steady state creep rate of polycrystalline unalloyed tungsten was examined based on the extensive published data available. It was shown that the steady state creep rate of polycrystalline tungsten, and other metals, is given by $\dot{\epsilon} = S\lambda^2 D_{eff} (\sigma/E)^7$ where λ = subgrain size, σ = creep stress, E = average unrelaxed elastic modulus, and S is a universal creep constant equal to about 3×10^{40} cm^{-4}. The effective diffusion coefficient, D_{eff}, equals $(D_L f_L + D_D f_D)$ where D_L is the lattice diffusion coefficient, D_D is the dislocation diffusion coefficient, and f_L and f_D are the fraction of atoms participating in lattice and dislocation diffusion respectively. When subgrains form during creep, as in normal behaving materials, $\lambda = k\sigma^{-1}$ (k is a material constant) and the above equation yields the generally observed five power stress for creep. When subgrains do not form during creep (as in many refractory metals produced by powder metallurgy techniques), λ in the above equation is replaced by the grain size. In this case $\dot{\epsilon} \alpha \sigma^7$ and $\dot{\epsilon} \alpha L^{-2}$, predictions in agreement with experimental evidence. The power law breakdown for creep at high stresses can be explained by one of two possibilities: the creation of excess vacancies by plastic deformation which increases D_L in the D_{eff} term, or the increase in dislocation density with increasing stress, which influences the dislocation diffusion term, $D_D f_D$, in D_{eff}. (auth)

10216 INTERNAL FRICTION AS A FUNCTION OF DEFORMATION IN URANIUM. Terras, Christiane; Delarue, Gerard (CEA, Montrouge, France). Compt. Rend., Ser. C, 267: 1388-91(Nov. 18, 1968). (In French).

The internal friction of uranium was measured as a function of the amplitude of deformation. Tempering induced an increase in internal friction, while preliminary deformations by traction have a more marked effect than the magnitude of the deformation would indicate. (tr-auth)

10217 ON THE MEASUREMENT OF FRACTURE DUCTILITY WITH TENSILE TEST PIECES WITH A NOTCH ON ONE SIDE. Takai, Koichi; Kobayashi, Toshiro (Fuji Electric Mfg. Co., Ltd., Japan). Tetsu To Hagane, 54: 373-6(Aug. 1968). (In Japanese).

Small, cracked-notched test pieces of improved steel plate of AST MA302B and HY80 steel plate for use in nuclear reactor pressure vessels were tensile tested to determine fracture ductility. As used, eccentric loads were imposed on the test pieces due to the cracks on one side. The equation for computing the stress magnifying coefficient was established. At the start of crack propagation, the low stress fracture was determined by nitriding the free surface of the test piece. The fracture ductility determined was the value for the time of start of crack propagation, and differed from the value of the nitrided test piece, which agreed with the value at the time of halt of crack propagation. The view was taken that the fracture ductility level of plane strain was not reached even in the nitrided test piece, judged by the analysis of area of the plastic region at the tip of crack. The ability of the employed test pieces to measure the fracture ductility was reviewed. (NSA of Japan)

10218 DISSOCIATION OF HYDROGEN ON TANTALUM USING A MODULATED MOLECULAR BEAM TECHNIQUE. Krakowski, R. A.; Olander, D. R. (Univ. of California, Berkeley). J. Chem. Phys., 49: 5027-41(Dec. 1, 1968).

A molecular beam-mass spectrometric apparatus was developed to study the kinetics of gas-solid reactions at low pressures. The

system was used in an investigation of the dissociation of hydrogen on tantalum. A modulated beam of molecular hydrogen, formed by effusion from a multichannel source, impinged upon the tantalum target. The reflected H_2 and H atoms emitted after surface dissociation were monitored by a mass spectrometer in the vacuum system. The beams were modulated and the products measured by a phase-sensitive detector to improve the signal-to-noise characteristics of the detection system. The degree of dissociation was studied as a function of the surface temperature, beam temperature, and beam intensity. For a fixed target temperature, dissociation increased with beam temperature with an apparent activation energy of 1.4 kcal/mole. The rate of dissociation varied linearly with beam intensity. Mixed hydrogen–deuterium beams were employed to investigate the isotope exchange reaction, which, within the sensitivity of the detection system, did not take place. The results are consistent with a model in which the surface concentration of hydrogen is controlled by competition between atom evaporation and surface diffusion. The presence of the latter loss mechanism reduces the surface concentration to the point where second-order recombination is negligible. The atom-evaporation and surface-diffusion processes are satisfactorily described by the two-dimensional ideal-gas model. Collisions occur between migrating adatoms and scattering centers on the surface. The mean free path for this interaction was 0.02 cm for all temperatures investigated. (auth)

10219 COMBINED SOLUBILITY OF TUNGSTEN AND BORON IN MOLYBDENUM. Kharitonov, V. I.; Makunin, M. S.; Shamrai, F. I. Izv. Akad. Nauk SSSR, Metal., No. 6, 227-31(Nov.-Dec. 1968). (In Russian).

The combined solubility of tungsten and boron in MoW_2B_2 at 1100°C is 0.0085 wt % B and 0.071 wt % W; at 1700°C it is ~0.012 wt % B and 0.1 wt % W. The minimum solubility was less than 0.005 wt % B and 0.2 wt % W at 1100°C. The combined solubility of these elements increased with temperature and decreased in proportion to the increase in tungsten content. (tr-auth)

Structure and Phase Studies

Refer also to abstracts 10235 and 11178.

10220 (ANL–7258) THORIUM–URANIUM–PLUTONIUM ALLOYS AS POTENTIAL FAST POWER-REACTOR FUELS. PART I. THORIUM–URANIUM–PLUTONIUM PHASE DIAGRAM. Blumenthal, B.; Sanecki, J. E.; Busch, D. E. (Argonne National Lab., Ill.). Sept. 1968. Contract W-31-109-eng-38. 60p. Dep. CFSTI.

The ternary Th–U–Pu system was investigated by means of metallography, room- and high-temperature x-ray diffraction, dilatometry, electrical resistance measurements, and differential thermal analysis. The liquid miscibility gap is restricted to the Th–U side of the system. A eutectic trough connects the Th–U and Th–Pu sides of the diagram. The peritectic reaction $\alpha_{Th} + L \rightarrow C$ ($C = Pu_xTh_{1-x}$) of the Th–Pu binary at 615°C joins the eutectic trough in a ternary peritectic reaction $\alpha_{Th} + \epsilon_{Pu} + L \rightarrow C$ at 630°C. In the solid state, three 4-phase reactions occur involving α_{Th} and the phases on the uranium side of the U–Pu system: a class III reaction $\alpha_{Th} + \beta U + \gamma U \rightarrow \eta$ at 714°C, a class III reaction $\alpha_{Th} + \beta_U + \eta \rightarrow \zeta$ at 610°C, and a class II reaction $\alpha_{Th} + \beta_U \rightarrow \alpha_U + \zeta$ at 595°C. Over a wide range of compositions the ternary alloys are in equilibrium with α_{Th} and the phases of the binary U–Pu system. The addition of uranium to the Th–Pu solid solution greatly lowers the solid solubility of plutonium in thorium. Alloys of potential use as fast reactor fuels are restricted to a relatively small range of compositions with no more than 10 at. % Pu and up to 25 at. % U. The Th–U–Pu ternary system resembles other U–Pu systems to which a third element has been added, notably Mo, Ti, or Zr. In all four systems, the zeta phase forms by a peritectoid class III reaction, and the solubility of zeta for the third element is small. No such uniformity applies to the formation of the η phase in the four ternary systems. (auth)

10221 DEFORMATION AND FRACTURE OF BERYLLIUM BICRYSTALS. Damiano, V. V. (Franklin Inst. Research Labs., Philadelphia); London, G. J.; Kaufman, D. F.; Aronin, L. R. Trans. Met. Soc. AIME, 242: 2423-31(Dec. 1968).

Beryllium bicrystals were prepared by a seeding and floating zone-melting technique from high-purity beryllium single-crystal material. The starting material was given six floating zone purification passes prior to producing the bicrystals. Symmetric, asymmetric, and antisymmetric bicrystals were tested in tension. Included were bicrystals with boundaries both parallel and perpendicular to the tension axis. Modified symmetric bicrystals were also examined in detail. In these cases, the angles made by the slip planes with the boundary were not equal. Failure by (0001) cleavage, $\{11\bar{2}0\}$ cleavage, and boundary separation were all observed depending on the orientation of these cleavage planes and the boundary with respect to the tension axis. Failure occurred on whichever system experienced the greatest normal stress. The origin of the fractures observed and the operative dislocation mechanisms were investigated by fractography and transmission electron microscopy. The results indicate that low-angle boundaries form in close proximity to the bicrystal boundary and act as sites for crack nucleation. It has been concluded that, although macroscopic compatibility was satisfied in many of the bicrystals examined, the bicrystal boundary was effective in producing early failure by local bend plane formation as plastic deformation proceeded, followed by cleavage initiation and crack propagation. (auth)

10222 PHASE TRANSFORMATIONS IN Ti–Mo AND Ti–V ALLOYS. Blackburn, M. J.; Williams, J. C. (Boeing Scientific Research Labs., Seattle). Trans. Met. Soc. AIME, 242: 2461-9 (Dec. 1968).

Several of the decomposition processes that can occur in supersaturated β phases in a Ti–11.6 wt % Mo and a Ti–20 wt % V alloy have been studied by transmission electron microscopy. The deformation induced martensitic phase in the Ti–Mo alloy has been found to have a bcc or bct structure rather than the previously reported hexagonal structure. The morphology of the transformed region is a rather complex assemblage of twins, twinning occurring in one or more systems; this internal twinning has been found to occur on {112}. The ω phase is formed in both alloys on aging and is present in the Ti–Mo alloy after quenching. The structure of this phase has been confirmed as hexagonal in both systems, however, differences in morphology and stability are found between the two alloys. Thus in the Ti–Mo alloy the ω phase has an ellipsoidal morphology with the major axis lying parallel to $\langle 111 \rangle_\beta$ or $[0001]_\omega$ while in the Ti–V alloy the phase forms as cubes, the cube faces lying parallel to $\{100\}_\beta$ or $\{20\bar{2}1\}_\omega$. Some observations on the particle sizes, volume fraction, and composition of the ω phase in the Ti–Mo alloy are listed. The mode of formation of the α phase from the $(\beta + \omega)$ structures is also different in the two alloys. In the Ti–Mo alloy the α phase is formed by either a cellular reaction or by the growth of isolated needles, whereas in the Ti–V alloy the α phase is nucleated at an $\omega : \beta$ interface and grows to consume the ω phase. Some of the differences in behavior of the ω phase are attributed to the mismatch between it and the solute enriched β matrix in which it forms. (auth)

10223 TERBIUM–RHENIUM SYSTEM. Khamidov, O. Kh.; Savitskii, E. M. (Inst. of Metallurgy, Dushanbe, USSR. Inst. of Chemistry, Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR, 11: No. 9, 39-41(1968). (In Russian).

The phase diagram of the Tb–Re system was constructed; total solubility in the liquid state and negligible solubility in the solid state were confirmed. $TbRe_2$, formed in the peritectic reaction liquid $\simeq \alpha$-Re + $TbRe_2$, was found at 2400 ± 50°C. Nearly pure Tb eutectoids were formed at 1300 ± 10°C. (R.V.J.)

10224 COPPER ANGLE OF Cu–Ni–Zr PHASE DIAGRAM. Fedorov, V. N.; Zakharov, M. V.; Kucherov, V. I.; Ivanova, G. S. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 5, 74-7(1968). (In Russian).

Microhardness and microscopic analysis of the phase diagram of Cu–Ni–Zr alloys (2% Ni and 2% Zr) showed that Ni in copper increased the melting point of the alloy and increased Zr solubility in solid solution at all studied temperatures (600, 700, 800, and 900°C). (R.V.J.)

10225 BOND ENERGY DETERMINATION IN TWO-DIMENSIONAL CRYSTALS OF ZIRCONIUM ADSORBED ON TUNGSTEN AND NIOBIUM. Odishariya, G. A.; Shrednik, V. N. (Leningrad Inst. of Physics and Tech.). Dokl. Akad. Nauk SSSR, 182: 542-4 (Sept. 21, 1968). (In Russian).

The supporting layer may affect the structure of two-dimensional crystals; the interaction of the absorbed particles and the supporting layer may be studied by measuring the bond energy. A projecting microscope was used to investigate the growth and disappearance of two-dimensional Zr crystals on the surface of single crystals of W and Nb, determining the bond energy of Zr in the two-dimensional lattice on the basis of Arrhenius curves which indicate the temperature dependence of these processes. The monoatomic layers yielded sufficient emission contrast. The bond energy in the two-dimensional Zr crystal was calculated from the difference of the sublimation energy and the migration energy. The results indicated that the cohesion energy in the two-dimensional lattice is fairly large; the crystallization blocks the migration process. The bond energy which should depend only on the distance between the Zr atoms and on the distribution of these atoms, was found to be larger near the [001] grains. It was also found that the bond energy was larger in case of W support than

for Nb. From theoretical considerations it was assumed that the bond energy is one-half of the heat of sublimation, or 3.15 eV; this agrees with the measured value of 3.05 eV. (TTT)

10226 LATTICE DEFECTS IN FACE-CENTERED CUBIC METALS. Fortes, M. A. Cambridge, Eng., Cambridge Univ., 1968.
Thesis.
Experimental and theoretical work is described under the following main headings: fundamental aspects of field-ion microscopy; some considerations relating to the interpretation of field-ion images; contrast from lattice defects; effects of field stresses in specimens; spot counts and their application to study of impurities and radiation damage; growth of oxide on field-ion specimens of iridium. (UK)

10227 CONCERNING THE COMBINED SOLID-STATE SOLUBILITY OF TUNGSTEN AND BORON IN MOLYBDENUM. Kharitonov, V. I.; Makunin, M. S.; Shamrai, F. I. Tsvetn. Metal., No. 9, 84-6(Sept. 1968). (In Russian).
Data are presented on the continuous order of solid solutions in the Mo–W system and on the solubility of boron in molybdenum. The solubility was determined by chemical microstructural analysis, hardness, and microsolidity of alloys on electron-beam melting. It was shown that the combined solubility of tungsten and boron in molybdenum depends strongly on temperature. The solubility of boron also depends on the concentration of tungsten. (tr-auth)

10228 PHASE EQUILIBRIA IN THE SYSTEMS Mg–Y AND Mg–Y–Mn. Sviderskaya, E. A.; Ladezhnova, E. M. Izv. Akad. Nauk SSSR, Metal., No. 6, 183-90(Nov.-Dec. 1968). (In Russian).
The Mg-Y phase diagram was studied by thermal analysis, microstructural investigations, and measurements of specific electric conductivity. In magnesium-rich alloys the eutectic transformation proceeded at 565°C and 26.6 wt % Y. The compound Y_3Mg_{24} is formed at 620°C. The maximum solubility of yttrium in solid magnesium at the eutectic temperature is 12 wt % (3.7 at. %). On lowering the temperature, the solubility of yttrium decreases and at 200°C is 2.2 wt %. In the magnesium-rich region of the Mg–Y–Mn alloy, an invariant eutectic transformation at 535°C was established. (tr-auth)

10229 PHASE DIAGRAM OF THE SYSTEM Tb–Re. Savitskii, E. M.; Khamidov, O. Kh. Izv. Akad. Nauk SSSR, Metal., No. 6, 158-62(Nov.-Dec. 1968). (In Russian).
The phase diagram of the Tb–Re alloy was constructed in the whole range of concentrations by physical-chemical analyses. It is characterized by complete reciprocal solubility of the components in each other in the liquid state and limited solubility in the solid state. A compound $TbRe_2$ was observed and a eutectic, close to the composition of pure terbium, at 1320 ± 10°C was found. In crystals of $TbRe_2$ a = 5.397 A, c = 8.797 A, and c/a = 1.63. (tr-auth)

10230 THE MAGNESIUM-RICH PART OF THE PHASE DIAGRAM FOR Mg–Y–Zn. Zaselyan, B. N.; Sal'dau, P. Ya.; Afanas'ev, S. K. Izv. Akad. Nauk SSSR, Metal., No. 6, 191-4 (Nov.-Dec. 1968). (In Russian).
The phase diagram for the magnesium-rich region of the Mg–Y–Zn alloy (up to 15 wt % Y and Zn) was constructed by physical-chemical methods of analysis. Magnesium forms solid solutions with yttrium and zinc. The solubility of alloying additions in magnesium decreases with decreasing temperature. Ternary solid solutions have lower concentrations of additives than binary. (tr-auth)

10231 PHASE EQUILIBRIA IN THE Ti–Al–Mo–Zr ALLOY. Volkova, M. A.; Kornilov, I. I. Izv. Akad. Nauk SSSR, Metal., No. 6, 195-200(Nov.-Dec. 1968). (In Russian).
The alloy was studied by thermal, microstructural, and x-ray analyses and by measurement of the specific electric conductivity and hardness. Polythermal sections of the system were constructed with constant contents of Al at 3, 6, 9, 12, 16, and 22%. The specific electric resistance of alloys of all sections, after tempering at 1100, 800, and 500°C, increased insignificantly with increasing contents of Mo and Zr. The hardness of the alloys was studied. (tr-auth)

10232 INVESTIGATION OF Ti–V–Cr–Mo ALLOYS. Budberg, P. B.; Samsonova, N. N. Izv. Akad. Nauk SSSR, Metal., No. 6, 201-5(Nov.-Dec. 1968). (In Russian).
The isothermal cross sections of the tetrahedral quaternary Ti–V–Cr–Mo system along the section $TiCr_2$–V–Mo were studied at 1300, 1200, 900, and 600°C. The section $TiCr_2$–V–Mo is quasiternary in the temperature range studied. The change in hardness was in complete agreement with the phase structure. (tr-auth)

Radiation Effects

Refer also to abstracts 9664, 10295, 11155, 11235, 11279, and 11354.

10233 (CEA-CONF–1108) FISSION DAMAGE IN α-URANIUM AT 4°K. Leteurtre, Jean (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1968]. 14p. (CONF-680910–5). Dep.
From International Conference on Vacancies and Interstitials in Metals, Juelich, Germany.
Samples irradiated at several burnups were examined. In order to explain micrographic results, and information about radiation damage in α-uranium, a coherent model was proposed for the fission particle effects. The number of point defects created by one initial fission is determined for pure and annealed metal. The importance of the self-anneal which occurs immediately in each displacement spike, and the anneal due to a new fission on the damage resulting from a previous fission, are estimated. The focussing distance in the [100] direction is found to be about 1000 Å, at 4°K. (auth)

10234 (CONF-680419–, pp 225-43) RADIATION EFFECTS TO REFRACTORY METALS AND ALLOYS. Moteff, John (General Electric Co., Cincinnati, Ohio).
A general review is made of the effects of neutron irradiation on the elevated temperature mechanical properties of refractory metals and alloys. Particular attention is paid to the importance of the irradiation and test temperature and to the resulting substructure on the observed changes in the mechanical properties. (auth)

10235 (COO–1198-585) ATOMIC MECHANISMS DURING THE ANNEALING OF IRRADIATED METALS. Koehler, J. S. (Illinois Univ., Urbana). Sept. 1968. 18p. (CONF-680910–4). Dep. CFSTI.
From International Conference on Vacancies and Interstitials in Metals, Juelich, Germany.
Unresolved problems associated with annealing stages I and II are described. Evidence which supports the assignment of stage III annealing in irradiated gold and aluminum to vacancy migration is described. Electron microscope pictures of interstitial clusters in electron irradiated gold observed below stage III are described. It is shown that the interaction between interstitial clusters and migrating vacancies reduces the number of jumps to annihilation by a factor of thirty to sixty in aluminum and gold. Possible reasons for the second order annealing kinetics are examined. Remaining problems in copper and silver are mentioned. (auth)

10236 (EURFNR-566) MULTI-AXIAL IN-REACTOR STRESS-RUPTURE STRENGTH OF STAINLESS STEELS AND A NICKEL-ALLOY. Laue, H. J.; Bohm, H.; Hauck, H. (Kernforschungszentrum, Karlsruhe (West Germany)). Aug. 1968. 14p. (EUR-3972; KFK-814; CONF-680604–9).
Work Performed under United States–Euratom Fast Reactor Exchange Program.
From Symposium on Radiation Effects to Reactor Metals, San Francisco, Calif.
The stress-rupture strength and tangential rupture strain of the stainless steels $^{16}/_{13}$ CrNi and $^{20}/_{25}$ CrNi, Inconel 625, and Incoloy 800 cladding materials were determined under irradiation between 600 and 700°C. The irradiations were performed in the Belgian Reactor BR2 with a fast neutron flux betwen 2.5 and 4.0×10^{14} n/cm^{2}sec. The stress-rupture strength was reduced between 20 and 50% by irradiation. The highest decrease was measured on the complex alloys Inconel 625 and $^{16}/_{13}$ CrNi. The tangential rupture strain was reduced to absolute, values of 1%, with exception of the Ti- and Al-free Incoloy 800 (2.5 to 4.7%). (J.C.W.)

10237 (NYO–3653-3) STUDY OF RADIATION INDUCED DEFECTS IN METALS. Progress Report, November 3, 1967–November 15, 1968. Townsend, John R. (Pittsburgh Univ., Pa.). Nov. 15, 1968. Contract AT(30-1)-3653. 23p. Dep. CFSTI.
Experimental work on low temperature irradiation of Cu and W is discussed. Results reported for Cu were confirmed with the exception that the 10°K anelastic process was identified with close pairs based on its isochronal annealing behavior. Isochronal anneal curves of the resonant frequency at 4.2°K show much of the structure that resistivity annealing has shown. The detection of stress-induced ordering of the freely migrating interstitial remains ambiguous due to a background process involving dislocation damping. Tungsten has shown five different anelastic processes below 60°K including one near 10°K. There appear to be no dislocation processes to complicate the W results, so annealing experiments are less ambiguous. One anelastic process, centered

at 14°K, is actually created by the annealing of other defects. Bulk effect and pinning data seem to show a substantial dependence on crystal perfection. Computer simulation of a finite lattice with an applied pressure has resulted in numerical estimates of the elastic bulk effect of vacancies and interstitials in W on the bulk modulus. The results for the fractional change in the bulk modulus per atomic fraction of defects are +1.4 and −2.5 for interstitials and vacancies, respectively. Piezoresistance measurements were successfully made on oxygen impurities in Ta. Preliminary results suggest a very small effect in C and N doped iron samples. (auth)

10238 (ORNL-TM-2305) POSTIRRADIATION TENSILE AND CREEP-RUPTURE PROPERTIES OF SEVERAL EXPERIMENTAL HEATS OF INCOLOY 800 AT 700 AND 760°C. Harman, D. G. (Oak Ridge National Lab., Tenn.). Dec. 1968. Contract W-7405-eng-26. 31p. Dep. CFSTI.

Tensile and creep-rupture data have been obtained at 700 and 760°C for several experimental heats of Incoloy 800 that were irradiated in the ORR at elevated temperatures. Effects of composition, grain size, and carbide morphology were investigated. Enhanced postirradiation ductility was achieved for Incoloy 800 containing about 0.1% Ti in creep-rupture tests. The maximum ductility for this composition was obtained for the smaller grain sizes and at the lower creep stress levels and appeared to be independent of carbon content. Significant variations in properties (both control and postirradiation tests) were noted for alloys within the commercial Incoloy 800 composition specifications. The ductility peak at about 0.1% Ti is not fully understood; it might be best explained by two independent mechanisms, one accounting for the increasing ductility with increasing titanium at levels less than 0.1% and the other explaining the decreasing ductility at higher titanium levels. The grain size effect is thought to be due to differences in either helium distribution or stresses necessary for grain boundary fracture propagation. (auth)

10239 (SRARI-P-20) THE METALLIC BERYLLIUM BEHAVIOUR IN SM-2 REACTOR. Chechetkina, Z. I.; Gol'tsev, V. P.; Grechishkin, F. I.; Votinov, S. N.; Tsykanov, V. A.; Klimenkov, V. I. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1968. 19p. (In Russian). Dep.

After irradiation in the SM-2 Reactor, metallic beryllium was investigated to evaluate its radiation damage and determine its safety lifetime. Corrosion resistance, mechanical properties, dimensional stability, and structural changes were studied according to the irradiation dose and fission gases (helium and tritium) buildup. The effect of some technological factors on beryllium radiation stability was also considered. Some recommendations on beryllium use are given for the conditions analogous to SM-2 Reactor. (tr-auth)

10240 IRRADIATION PERFORMANCE OF FAST REACTOR URANIUM–PLUTONIUM METAL FUELS. Beck, W. N.; Brown, F. L.; Koprowski, B. J.; Kittel, J. H. (Argonne National Lab., Ill.). Nucl. Met., Met. Soc. AIME, 13: 507-23 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Irradiation studies are being performed on uranium–plutonium alloys as fuels for fast breeder reactors. The irradiation performance of the alloys is being evaluated as prototype elements in thermal reactors, and as full-size elements, in the fast reactor EBR-II. Of the alloys tested, the U–Pu–Zr system is the most attractive because of its good compatibility with stainless steel cladding and its greater resistance to fuel swelling. The alloy has been successfully irradiated to 12.5 at. % burnup at maximum clad temperatures of 655°C and at linear heat ratings of 11 kW/ft. Experiments will be used to evaluate the performance of this alloy at linear heat ratings of 15 to 20 kW/ft. (auth)

10241 1968 PORTEVIN LECTURE SPECIAL STEELS AND NUCLEAR RADIATIONS. Castro, R. Mem. Sci. Rev. Met., 65: 533-42 (July-Aug. 1968). (In French).

Permanent changes due to neutron radiation, changes due to atom displacement (structural perturbation, saturation effect, order-disorder transformations, phase shifts, accelerated precipitation, resistivity, density, mechanical properties) and changes due to decay are summarized. Radiation effects on the mechanical properties of C–Cr–Nb–Ni–steel are given. (J.C.W.)

10242 THE NATURE OF BLACK-SPOT DAMAGE IN IRRADIATED GOLD. Eades, J. A. (Cavendish Lab., Cambridge, Eng.). Phil. Mag., 19: 47-57 (Jan. 1969).

High-purity gold was irradiated with neutrons in a reactor and with high energy α particles and the resulting black-spot damage was examined by electron microscopy. From stereomicrographs of foils decorated on one surface it was possible to measure the distance of certain defects from that surface. The direction of black–white streaking of the defects was observed in the exact Bragg orientation. From this information the sign of the defects (whether they are of interstitial or of vacancy character) was deduced. Foils about 1000 Å thick were α-irradiated at room temperature and the black-spot defects found to be of interstitial type. In the neutron irradiation case, bulk material was irradiated at about 65°C and the defects were found to have a vacancy character. In each case the symmetry of the black–white images was such that the defects are thought to be Frank loops. The result of the sign determination for the α-irradiation is in conflict with previous results. The discrepancy is believed to result from a previously unremarked denuded layer 40 to 50 Å deep at the surface. (auth) (UK)

10243 EFFECT OF IRRADIATION ON STEELS USED IN PRESSURE VESSELS. Cowan, A.; Nichols, R. W. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). pp 229-35 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A review is made of the effect of neutron irradiation on steels used in prestressed concrete pressure vessels for an advanced gas-cooled reactor. The expected changes in properties are discussed in relation to the design and performance of the liner and the prestressing tendons. Data are given from experimental irradiations, and it is concluded that irradiation effects on the liner and tendons are not likely to lead to premature failure or to restrictions on operating conditions. (auth) (UK)

10244 ELIMINATION OF POINT DEFECTS BY DEFORMATION AT 78°K IN Al IRRADIATED WITH NEUTRONS. Dimitrov, Colette; Dimitrov, Omurtague (CNRS, Vitry-sur-Seine, France). Compt. Rend., Ser. C, 267: 1453-6 (Nov. 25, 1968). (In French).

In aluminum samples irradiated at 78°K, a slight deformation at the same temperature involves a drop in resistance. This phenomenon corresponds to an elimination of irradiation defects produced by the movement of dislocations. (tr-auth)

Ceramics and Cermets

Refer also to abstracts 10155 and 10156.

Corrosion and Erosion

10245 COMPATIBILITY OF (U,Pu) CARBIDES WITH POTENTIAL JACKETING MATERIALS. Latimer, T. W.; Jacoby, W. R. (Argonne National Lab., Ill. Westinghouse Advanced Research Div., Cheswick, Pa.). Nucl. Met., Met. Soc. AIME, 13: 322-34 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Observations were made of the extent and type of reaction of several iron-, nickel-, and vanadium-base alloys in contact with uranium–plutonium carbide compositions at 700 to 1100°C. Reaction zones were analyzed by means of metallography and an electron microprobe. Bands in which fine precipitates were found to a depth of approximately 25 microns were observed in some iron-base alloys after contact with (U,Pu)C for 1000 hours at 800°C. Reaction of (U,Pu)C with nickel-base alloys was characterized by the formation of $(U,Pu)Ni_5$ in the fuel, and the formation of a layer, having a relatively high chromium and carbon content, in the jacketing alloy. Addition of iron was shown to eliminate free uranium and plutonium from hypostoichiometric (U,Pu)C. $(U,Pu)Fe_2$ was found to have excellent compatibility with stainless steel at 800°C. (auth)

10246 PROPERTIES OF CARBIDES AND CARBONITRIDES. Pascard, R. (CEN, Fontenay-aux-Roses, France). Nucl. Met., Met. Soc. AIME, 13: 345-68 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The system (U,Pu)(CNO) was studied to establish a basis for selecting the best composition for a fast reactor fuel. Studies include phase diagrams, compatibility tests with stainless steel in sodium, and thermal diffusivity measurements. Irradiation experiments are recommended. (auth)

10247 URANIUM–PLUTONIUM NITRIDES: FABRICATION AND PROPERTIES. Pardue, W. M.; Rough, F. A.; Smith, R. A. (Battelle Memorial Inst., Columbus, Ohio). Nucl. Met., Met. Soc. AIME, 13: 369-81 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Synthesis of nitride powders has been accomplished by a suc-

cessive hydride-nitride-vacuum outgas treatment of the metallic elements. Densification of these powders into useful pellet or rod form can be accomplished by hot pressing or sintering. Properties of importance for reactor design have been measured and include volatilization tendencies relating to vapor-phase transport under thermal influences, thermal conductivity, and chemical stability of the fuels in contact with potential LMFBR (liquid metal fast breeder reactor) cladding and coolant materials. Grain-growth behavior of high-density specimens also has been determined. (auth)

Preparation and Fabrication

Refer also to abstracts 10177 and 11244.

10248 (ORNL-RMIC-10) STATUS OF CRYSTAL GROWTH IN THE UNITED STATES. Billington, D. S. (Oak Ridge National Lab., Tenn.); Danielson, G. C. (Ames Lab., Iowa). Dec. 1968. Contract W-7405-eng-26. 11p. Dep. CFSTI.

The demand for high purity single crystals by the United States research community is discussed. An attempt was made to determine the extent to which crystal growth is regarded as a basic science as exemplified by university interest in teaching and research in this field. It was concluded that the crystal growth community is an active and important part of the solid state community that is attempting to make crystal growth a science; the crystal growth community is finding the means to publish and to hold meetings that are germane to its business; there is a demand for crystals and crystal growers for both technological and research applications; university interest in crystal growth is mostly for research use; and it is important that support and encouragement be given to this segment of the solid state community. (R.C.K.)

10249 Al–Al_2O_3 STRUCTURES FOR NUCLEAR APPLICATIONS AND PROCESS FOR OBTAINING SAME. Gualandi, D.; Jehenson, P. (to EURATOM). Canadian Patent 793,244. Aug. 27, 1968. Priority date Mar. 31, 1965, Italy.

The metallurgical processes such as pulverizing, grinding, oxidizing, and other requirements for production of SAP are described. Special precautions are taken to prevent the introduction of impurities at any stage and to promote a uniform distribution of Al_2O_3 which is necessary for desirable nuclear uses. (F.S.A.)

10250 PROCESS OF MAKING HIGH LOADED UO_2–COLUMBIUM CERMETS. Gordon, E.; Fuhrman, N. (to United States Atomic Energy Commission). U. S. Patent 3,419,387. Dec. 31, 1968.

A process for producing UO_2–Nb cermets having ceramic phase loadings of over 70 volume percent is described. UO_2 spheres are coated sequentially with wax, then with Nb powder. Pressure is applied to the coated spheres to form a compact, and the compact is heated to a temperature of less than 900°C for dewaxing. In the final step the compact is sintered. (auth)

10251 PLUTONIUM–URANIUM DIOXIDE POWDER AND PELLET FUEL MANUFACTURE. Caldwell, C. S.; Puechl, K. H. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Nucl. Met., Met. Soc. AIME, 13: 174-94 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Plutonium–uranium dioxide powder preparation and pellet fuel manufacturing methods have been developed to meet increasing demands for critical assembly, test reactor, and demonstration power reactor fuel elements. A review of current conversion and fabrication processes is presented and techniques for control of mixed-oxide pellet characteristics including plutonium microhomogeneity and oxygen/metal ratio are discussed. Experience gained during fabrication of thermal recycle and fast breeder type PuO_2–UO_2 fuel materials in quantities up to 500 kg is presented. Product variability data are included. (auth)

10252 SOL-GEL URANIA–PLUTONIA MICROSPHERE PREPARATION AND FABRICATION INTO FUEL RODS. Kitts, F. G.; Fitts, R. B.; Olsen, A. R. (Oak Ridge National Lab., Tenn.). Nucl. Met., Met. Soc. AIME, 13: 195-210 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The sol-gel process provides an intimate mixture of fissile and fertile elements in an oxide of almost theoretical density. The preparation of UO_2–PuO_2 microspheres and the development of a low-energy vibratory compaction technique (Sphere–Pac) for using these particles to prepare cylindrical fuel rods is discussed. Mixed-oxide microspheres are prepared in ~100-g batches in a facility consisting of glove boxes. Plutonia sol is formed by precipitation of the hydrous oxide from nitrate solution using excess NH_4OH, thorough washing of the precipitate, peptization at a NO_3^-/Pu mole ratio of 2, thermal denitration to a NO_3^-/Pu ratio of 0.1–0.2, and resuspension in water to a concentration of ~300 g of Pu per liter. This material is mixed with urania sol to obtain the desired composition. Microspheres are formed by dispersing the homogeneous mixture in 2-ethyl-1-hexanol, which dries the droplets to gel spheres. After separation of the gel from the alcohol and further drying, firing to 1100°C yields dense microspheres. The Sphere–Pac fabrication process, employing the sequential loading of two size fractions of these microspheres into vibrated tubes, yields a volume packing density approaching 85%. Laboratory experiments show that the best Sphere–Pac results are obtained using ~400 and <44-μ-dia spheres and mixed axial and lateral vibration at 60 CPS. The test fuel rods are closed by remote, automatic, tungsten inert gas welding techniques. Since nitrate solutions are the starting materials for both sols, the sol-gel approach to refabrication is consistent with established recycle technology. The adaptability of PuO_2 sol and UO_2–PuO_2 microsphere forming to semiremote techniques, necessitated by the accumulation of heavy-isotope radioactivity with recycle, will be demonstrated in a new facility. The Sphere–Pac technique appears to be well suited to remote fabrication. The irradiation performance of sol-gel-derived mixed-oxide microspheres fabricated by the Sphere–Pac technique is being determined. (auth)

10253 A SIMPLIFIED SOL–GEL METHOD FOR MIXED OXIDE FUELS. Cogliati, G.; Schileo, G. (CNEN, Rome). Nucl. Met., Met. Soc. AIME, 13: 211-30 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Microparticles of plutonium, uranium–plutonium and thorium–plutonium oxides of a controlled size (up to 600 microns), nearly theoretical density, low surface area, and good crushing strength, were produced. The starting materials were colloidal urania or thoria sols, as those used for the previous urania sol-gel process developed by CNEN, and plutonia sols with a relatively high nitrate content. Plutonia sols with NO_3^-/Pu mole ratios between 1 and 1.5 were prepared from plutonium nitrate solutions by extraction of nitrate by strong-base amines and evaporation to the desired plutonium concentration. The sols then are dispersed as uniform droplets in an organic liquid by use of two-fluid nozzles. The droplets are suspended and converted to gel spheres by extraction of the residual nitrate by an amine dissolved in the solvent. The spheres are separated from the organic liquid, washed, dried, and calcined to 1200°C. The ability to produce dense plutonia, as well as homogeneous urania–plutonia or thoria–plutonia microparticles at any desired ratio has been demonstrated on a laboratory scale. The first specimen loaded with UO_2–16% PuO_2 is awaiting irradiation. (auth)

10254 MIXED URANIUM–PLUTONIUM OXIDE FUEL FABRICATION FOR RAPSODIE. Bataller, S.; Ganivet, M.; Guillet, H.; Masselot, Y.; Robillard, A.; Stosskopf, F. (CEA, Saclay, France). Nucl. Met., Met. Soc. AIME, 13: 231-48 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The fabrication of the 96 first elements for the Rapsodie reactor has been completed. It represents the use of 320 kg of mixed oxide $(U,Pu)O_2$ containing about 70 kg of plutonium. Fabrication, the total evaluation of the fabrication, and the yield of the various stages are described. Problems and difficulties raised by fabrication, and the studies devoted to the adjustments of the procedure for the fabrication of the low density oxide fuel are summarized. The specifications considered for the first charge pellets of the Phenix reactor are given. (auth)

10255 A PROCESS FOR THE PRODUCTION OF SPHERICAL FUEL ELEMENTS COMPRISING GRAPHITE. (to Nukem Nuklear-Chemie und-Metallurgie Gesellschaft mbH). British Patent 1,137,013. Dec. 18, 1968. Priority date Oct. 25, 1966, Germany.

A process for the production of fuel spheres is described in which the fuel is in a graphite matrix. The fertile material and graphite are molded in an elastic spherical-shaped mold under isostatic pressure. Air is evacuated from the material to be molded before pressing. After pressing, the pressings are heated to 1000°C in a protective gas atmosphere and calcined in vacuo at ~2000°C. (F.S.)

10256 (U–Pu)C PARTICULATE FUEL FABRICATION. Ayer, J. E. (Argonne National Lab., Ill.). Nucl. Met., Met. Soc. AIME, 13: 249-62 (1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

A series of uranium–plutonium carbide elements were fabricated for fuel element performance studies. The fuel elements were manufactured by vibratory compaction employing an infiltration technique. The loading process parameters were determined on the basis of model studies carried out on nonfissile materials.

Eleven rods containing 80% uranium carbide and 20% plutonium carbide and five rods containing solid-solution carbides were fabricated. The mixed carbide fuel elements were all loaded to smear densities of 80% of theoretical with the exception of one which was compacted to 83.8% theoretical density. The solid-solution rods were formed to fuel densities of 84.2 ± 1.3% of theoretical. Fabrication revealed that the packing characteristics of carbides deviated from the model studies due to attrition of the fuel material. In some cases 20 percent of the first component addition was reduced to finer screen sizes during loading. Uniformity of density is promoted by infiltration, although angular particles are conducive to low infiltration rates. (auth)

10257 PREPARATION OF UO_2 SINGLE CRYSTAL BY INDUCTION HEATING. Yajima, Seishi; Furuya, Hirotaka (Tohoku Univ., Japan). Nippon Genshiryoku Gakkaishi, 10: 632-6(Nov. 1968). (In Japanese).

A UO_2 single crystal 10 mm in diameter and 30 mm long was prepared by means of the floating zone technique. In N_2 at 5 atm pressure nitrogen, a sintered UO_2 rod, 17 mm in diameter and 150 mm long of 97% theoretical density, was heated by high frequency induction in a graphite pipe. The electronic conductivity of UO_2 increased with rising temperature. When the surface temperature of the pipe attained 1,100°C, the pipe was removed and the rod was heated directly by induction. The UO_2 rod was heated at a rate of 500°C/hr, until the surface temperature became 1,850°C (power supply 18 kW). At this temperature, about 70% of the cross section of the rod had melted, and the nonmelted outer portion acted as crucible. Then the rod was rotated at a speed of 100 rpm and at the same time raised at a rate of 5 mm/hr. After it reached a predetermined height, the rod was again lowered at the same rate to its original position. This double pass generated a single crystal in the central portion. Back reflection Laue photographs taken from different points of the specimen showed that the ⟨111⟩ direction was inclined at about 10° to the axis of the rod. No etch pits were found in the single crystal area. The result of spectroscopic analysis revealed that certain kinds of impurities were concentrated in the lower part. (NSA of Japan)

10258 METHOD OF MAKING SOLID SOLUTION CARBIDE–GRAPHITE COMPOSITIONS. Riley, Robert E.; Davidson, Keith V.; Taub, James M. (to United States Atomic Energy Commission). U. S. Patent 3,419,656. Dec. 31, 1968.

A method is given of forming solid solution carbide-graphite composites in which powdered graphite is mixed with the powdered carbides of tantalum and niobium. The mixture is hot pressed at 3050°C and 3200 psi. The composite has a composition of 54 volume percent graphite, the balance is carbides, and the ratio of niobium to tantalum carbide is in the range of 70 to 50 weight percent. (auth)

10259 A METHOD OF PREPARING SPHERICAL URANIUM NITRIDE PARTICLES HAVING A POROUS INTERIOR. Kizer, Donald E.; Lozier, Donald E. (to United States Atomic Energy Commission). U. S. Patent 3,417,167. Dec. 17, 1968.

A method of preparing spherical uranium nitride particles having a porous interior surrounded by a gas-tight casing is described. Irregular particles of uranium nitride are melted in a high-temperature plasma flame in a nitrogen atmosphere to partially convert the uranium nitride to uranium. The particles are heated at a temperature between 700°C and the melting point of uranium for one to two hours in nitrogen at a pressure lower than that at which U_2N_3 is formed. The particles are then heated at about 1400 to 1600°C in nitrogen for a time sufficient to completely nitride the particles. (auth)

10260 METHOD FOR PREPARING METAL OXIDE MICROSPHERES. Bowman, R. A.; Pilloton, R. L. (to United States Atomic Energy Commission). U. S. Patent 3,422,167. Jan. 14, 1969.

Metal oxide gel microspheres of alumina, zirconia, hafnia, europia, thoria, urania, plutonia, and mixtures thereof, formed by jetting a corresponding metal oxide sol into a freezing medium, are frozen, subsequently dehydrated by vacuum distillation after removal of the freezing medium, and calcined into fired products. (AEC)

10261 PROCESS FOR PREPARING THORIUM DIOXIDE–URANIUM DIOXIDE SOL. Fitch, Frederick T.; Smith, Jean G. (to W. R. Grace and Co.). U. S. Patent 3,409,557. Nov. 5, 1968. Filed Dec. 21, 1966.

A process for preparing a mixed ThO_2–UO_2 sol comprises autoclaving a mixture of hydrous oxides of Th and U in the tetravalent state or a mixture of salts of Th(IV) and U(IV) in which some of the anion valence sites in each salt are filled with hydroxyl radicals, cooling, and recovering the product sol. The autoclaving is carried out at temperatures of 100 to 200°C for 1 to 40 hr in a N_2 atmosphere. (Offic. Gaz.)

10262 ONE-STEP METHOD OF CONVERTING URANIUM HEXAFLUORIDE TO URANIUM COMPOUNDS. (to United States Atomic Energy Commission). British Patent 1,135,170. Dec. 4, 1968. Priority date Oct, 28, 1966, United States.

A method for preparing U compounds suitable for reactor fuels consists of contacting gaseous UF_6 with an alkali metal vapor, or a mixture of alkali metal vapors, and an O-free gas containing either N_2, C, S, Si, or P, depending on whether the nitride, carbide, sulfide, silicide, or phosphide of U is to be prepared. The mixture is heated at a temperature of 800 to 1300°C and a pressure of less than 25 torr. (B.L.M.)

10263 IMPROVEMENTS IN OR RELATING TO A METHOD OF, AND APPARATUS FOR, RENDERING PARTICLES SPHEROIDAL. Nybo, Sigurd Andreas (to United Kingdom Atomic Energy Authority). British Patent 1,137,713. Dec. 27, 1968. Filed Mar. 5, 1965.

The device described is essentially a rotor mounted about a substantially horizontal axis which has a continuous circumferential particle-retaining channel of curved cross section, concave to the rotor axis, in its periphery, the channel following a path which, is substantially equidistant from the axis of rotation, but does not lie in a plane perpendicular to that axis. Details are given of an application for preparing nuclear fuel particles from a mixture of the powdered fuel material, e.g., uranium oxide, with a binder, for example furfuryl alcohol. (UK)

10264 CARBIDE DEPOSITION ON TANTALUM. McGuire, Joseph C.; Wohlberg, Cornel (to United States Atomic Energy Commission). U. S. Patent 3,421,953. Jan. 14, 1969.

A method of carburizing the inside surface of a tantalum tube closed at one end by soaking a porous graphite rod with a high molecular weight fluid hydrocarbon is described. The graphite rod is smaller in diameter than the inside diameter of the tube. The rod is inserted into the tube and inductively heated under vacuum conditions. (AEC)

10265 FABRICATION OF CERAMIC COMPONENTS FOR USE IN PLUTONIUM ELECTROREFINING. Stoddard, S. D.; Nuckolls, D. E. (Los Alamos Scientific Lab., N. Mex.). Nucl. Appl., 6: 156-62(Feb. 1969).

Fabrication methods have been developed to produce cells, sheaths, and stirrers of monolithic, impervious, high purity Al_2O_3 and MgO ceramics to satisfy the rigorous requirements for the electrorefining or electrowinning the Pu. Plutonium metal produced utilizing these components is currently used by the National Bureau of Standards as a certified analytical standard. (auth)

10266 ZIRCONIUM MOLYBDATE AND ITS PROPERTIES. Novoselov, G. P.; Ustinov, O. A. Zh. Neorg. Khim., 13: 3170-1(Dec., 1968). (In Russian).

The reaction of zirconium dioxide with molybdenum trioxide was studied. The formation of $ZrMo_2O_8$ was confirmed in the temperature range from 630 to 653°C. The melting point of the molybdate was found to be 1060°C. A phase diagram was constructed. (tr-auth)

10267 HEXABORIDES OF RARE EARTH ELEMENTS. Mordovin, O. A.; Timofeeva, E. N. Zh. Neorg. Khim., 13: 3155-8 (Dec. 1968). (In Russian).

Optimum parameters for preparation of hexaborides of La, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Yb, and Lu by the borothermal method were established. Their densities were verified and their melting points determined. A metallographic analysis was conducted on the fused rare earth hexaborides. (tr-auth)

10268 CONTRIBUTION TO THE STUDY OF THE WELDING OF SAP FOR NUCLEAR FUEL ELEMENTS. Dumont, C. (EURATOM, Ispra, Italy); Jullien, M.; Moneyron, G.; Savornin, B. Mem. Sci. Rev. Met., 65: 669-83(Sept. 1968). (In French).

Results are presented of tests conducted to study the welding performance of SAP with 7% Al_2O_3, which will be used in fuel elements for the ORGEL reactor. Tests on three can sections were performed. The parameters which influence scatter of results were studied. (auth)

10269 NEWER FORMS OF CARBON AND THEIR USES. Cahn, R. W.; Harris, B. (Univ. of Sussex, Brighton, Eng.). Nature (London), 221: 132-41(Jan. 11, 1969).

Details are given of the manufacture and properties of some of the more sophisticated forms of carbon, including nuclear graphites, pyrolytic graphite, vitreous carbon, whiskers and fibres, intercalation graphite compounds, and graphite crystals. (UK)

Properties Evaluations

Refer also to abstracts 9391, 9655, 10185, 10188, 10269, 10294, 10724, 11235, 11236, and 11351.

10270 (ORNL-TM-2357) FUELS FOR WATER REACTORS. Scott, J. L.; Weaver, S. C. (Oak Ridge National Lab., Tenn.). Dec. 1968. Contract W-7405-eng-26. 25p. Dep. CFSTI.

Uranium dioxide (UO_2) is universally selected as fuel for water reactors because of its superior compatibility with stainless steel or Zircaloy cladding, excellent irradiation stability, low reactivity with water, and low fabrication costs compared with metallic fuels, carbides, or nitrides. Pellets are generally preferred although considerable attention has been given to vibratorily compacted fuel, particularly for recycle. Because of service requirements, tight specifications must be met on trace element levels and fuel density; and for pelletized fuels, the shape of the pellet and the presence of chips or laminations are important. The irradiation behavior of UO_2 is influenced markedly by its low thermal conductivity and vaporization behavior. Under normal operating conditions, the fuel may be divided into three temperature zones, each of which has its individual character regarding fission-gas release and fuel swelling. At heat ratings in current reactors both thermal stress cracking and void redistribution occur, affecting performance. With proper design, peak heat ratings of about 20 kW/ft to burnups of 30,000 MWd/mt are permissible. Transients producing gross center melting can be tolerated provided there is sufficient free volume to accomodate the 7% fuel volume increase and the fission product gases from the melted zone and provided the subsequent thermal history is controlled. (auth)

10271 CENTRAL STATION FAST BREEDER-REACTOR PLUTONIUM FUEL REQUIREMENT: JAPANESE EXPERIENCE. Nakamura, Y. (Tokyo Works, Power Reactor, and Nuclear Fuel Development Corp.). Nucl. Met., Met. Soc. AIME, 13: 48-57(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

A development program of fast breeder reactors has been initiated. Design studies on 1000 MWe breeder are discussed from the standpoint of fuel technology. The present status of plutonium fuel development for the JFER is described. (auth)

10272 CENTRAL STATION FAST BREEDER REACTOR: PLUTONIUM FUEL REQUIREMENTS FRENCH PROGRAM. Sebilleau, F.; Zaleski, C. P. (CEA, Fontenay-aux-Roses, France). Nucl. Met., Met. Soc. AIME, 13: 28-35(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Mixed uranium–plutonium oxide fuel development ensures continuity of effort from Rapsodie to the large fast reactors to be built. For Phenix (250 MWe) the plans are to use pellet type fuel made by a sintering process and stainless steel canning. For economics and fabrication reasons, effort is directed toward improvement of industrial stainless steel though noticeable work is performed on nickel based alloys. Carbides and carbonitrides are studied. Fabrication processes such as vibrocompaction and other types of fuel such as vented fuels are studied. They are considered as solutions which could provide better economics of the fuel cycle for large breeder reactors. (auth)

10273 THE BINARY SYSTEM CaO–Ta_2O_5. Reeve, D. A. (Dept. of Energy, Mines and Resources, Ottawa). J. Less-Common Metals, 17: 215-22(Feb. 1969).

A phase diagram for the CaO–Ta_2O_5 binary system has been plotted from results obtained using sub-solidus sintering, differential thermal analysis, hot-stage microscopy and an iridium-strip furnace. The compound $CaO \cdot 2Ta_2O_5$ melts incongruently at 1730°C and the compounds α-$CaO \cdot Ta_2O_5$ and $2CaO \cdot Ta_2O_5$ melt congruently at 1958 and 1896°C, respectively. The $\alpha \rightleftharpoons \beta$ $CaO \cdot Ta_2O_5$ polymorphic transition occurs at 1558 ± 5°C. X-ray data are given for two previously unreported calcium tantalates having the stoichiometric compositions $4CaO \cdot Ta_2O_5$ and $5CaO \cdot Ta_2O_5$, respectively. These two compounds formed a solid-solution area in the phase diagram at temperatures above 1590°C and this single-phase region is postulated to terminate at 1990°C, the incongruent melting point of $4CaO \cdot Ta_2O_5$. (auth)

10274 PHASE EQUILIBRIA IN THE HfO_2–Sc_2O_3 SYSTEM. Kalinovskaya, G. A.; Spiridonov, F. M.; Komissarova, L. N. (Moscow State Univ.). J. Less-Common Metals, 17: 151-9 (Feb. 1969).

Phase relations in the HfO_2–Sc_2O_3 system have been studied by thermal and x-ray analysis, and the phase diagram has been plotted. Three binary oxides have been observed in the system—all in the regions of high concentration of HfO_2,—viz., $Sc_2Hf_7O_{17}$, $Sc_2Hf_5O_{13}$, and $Sc_4Hf_3O_{12}$. These exhibit different ranges of homogeneity and are separated from one another by two-phase regions. The solubility of pure scandium oxide in hafnium oxide is very small, even at elevated temperatures, but the solubility of HfO_2 in Sc_2O_3 increases from about 17 mol. % HfO_2 at 1200°C to 22 mol. % at 2000°C. (auth)

10275 THERMAL CONDUCTIVITY OF URANIUM–PLUTONIUM OXIDE FUELS. Baily, W. E. (General Electric Co., Sunnyvale, Calif.); Aitken, E. A.; Asamoto, R. R.; Craig, C. N. Nucl. Met., Met. Soc. AIME, 13: 293-308(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Thermal conductivity measurements from both in- and out-of-pile experiments are summarized and indicate that stoichiometric mixed oxide fuels at near the 20 wt % PuO_2 composition exhibit an integral to melting value of 86 watts/cm. Hypostoichiometric compositions indicate a higher value at 89 watts/cm. The results of these measurements also indicate that the mixed oxide fuel has a slightly lower conductivity than UO_2. A new model, derived experimentally, has been developed for correcting thermal conductivity for density. This model indicates that the standard Loeb correction is not valid, and that the density correction is a function of temperature. Experiments to measure the effect of burnup on the conductivity of mixed oxide fuel indicate that there is no gross change in the integrated conductivity to melting. (auth)

10276 HEAT CONDUCTIVITY OF URANIUM PLUTONIUM MIXED OXIDES. Mattys, H. M. (EURATOM, Karlsruhe, Ger.). Nucl. Met., Met. Soc. AIME, 13: 291-2(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

The thermal conductivity and the thermal diffusivity of uranium–plutonium mixed oxide pellets with different oxygen contents have been measured. All specimens had a density very close to 94% of the crystallographic value. Stoichiometry changes were introduced by appropriate heat treatment of the samples under reducing or slightly oxidizing atmosphere. Mean value curves of the results of conductivity measurements obtained with a stationary, absolute, longitudinal heat flow method are given. Stoichiometric samples (with O/M-ratios between 1,997 and 2,000) exhibit the highest conductivities within the observed temperature range. At 200 to 800°C, the results may be represented analytically by $K = (A + Bt)^{-1}$, where the stoichiometry dependence of A can be related to the variation of the phonon mean free path due to the presence of excess oxygen atoms or oxygen vacancies. The diffusivity of mixed uranium–plutonium oxide, measured at 800 and 1700°C on two hypostoichiometric samples varies with oxygen concentration in the same manner as the conductivity at lower temperature. (auth)

10277 CARBON AND GRAPHITE HANDBOOK. Mantell, Charles L. New York, John Wiley and Sons, Inc., 1968. 546p. $18.50.

Carbon as an element, mineral forms, origin, applications, and products of restricted combustion, destructive distillation, and thermal decomposition are discussed. Fabrication of carbon and graphite articles, structural fabricated forms, machined fabricated forms, and control procedures are included. Artificial graphite for nuclear and other shapes is discussed for purification methods and all varieties are listed. (J.C.W.)

10278 THERMAL COEFFICIENT OF ELECTRICAL RESISTANCE OF SOME HIGH-MELTING COMPOUNDS AND THEIR SOLID SOLUTIONS. Grebenkina, V. G.; Denbnovetskaya, E. N. (Inst. of Problems in Material Studies, Kiev). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 2196-7(Dec. 1968). (In Russian).

Temperature coefficients of electrical resistance of the IV, V, and VI group solid solution carbides and silicides were studied. The x-ray phase analysis of the maximum solubility of the compounds: TiC–WC, ZrC–WC, VC–WC, NbC–TaC at 2600, 1800, 2300, and 2400°C, respectively, are tabulated. Data obtained for high-melting compounds HfC, TaC, Cr_3C_2, W_2B_5, $NbSi_2$, $TaSi_2$, $MoSi_2$, and WSi_2 showed a much higher thermal coefficient of electrical resistance of silicides as compared with carbides and borides. (R.V.J.)

10279 THERMAL CONDUCTIVITY OF CUBIC MONOCARBIDES AND MONONITRIDES OF TRANSITION METALS. Neshpor, V. S. (Leningrad Inst. of Applied Chemistry). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 2200-2(Dec. 1968). (In Russian).

Thermal conductivity of cubic monocarbides and mononitrides such as TiC, ZrC, HfC, NbC, TaC, ScN, TiN, ZrN, HfN, VN, and NbN was studied. An analysis of the thermal conductibility dependence of monocarbides and mononitrides on their electric conductivity is included. (R.V.J.)

10280 MOVEMENT OF PORES IN SOLIDS. Nichols, F. A. (Westinghouse Electric Corp., W. Mifflin, Pa.). J. Metals, 21: 19-27(Jan. 1969).

The basics of the behavior of pores, both voids and bubbles, in solids, with and without driving forces, appear to be well-established. When no driving forces exist, the restraining effects of structural defects must be carefully considered in random-walk analyses. Also, the effects of faceting of pores due to anisotropy of surface tension are important. Effects of possible significance also include strain field interactions between pores or between pores and surfaces. When no driving force is applied, many normally small effects take on great importance and are elusive of quantitative analysis. The presence of a strong driving force may well swamp out these effects and thus provide results in agreement with predictions of an idealized theory. (auth)

10281 SPECIFIC HEAT OF URANIUM MONONITRIDE FROM 1.3 TO 4.6°K. Scarbrough, J. O.; Davis, H. L.; Fulkerson, W.; Betterton, J. O. Jr. (Oak Ridge National Lab., Tenn.). Phys. Rev., 176: 666-71(Dec. 10, 1968).

The specific heat of uranium mononitride was measured at temperatures from 1.3 to 4.6°K and was found to be of the form $\gamma T + \beta(T/\Theta_D)^3$, where γ is 24.79 ± 0.05 mJ(g at. wt)$^{-1}$ (deg)$^{-2}$ and the Debye Θ is 324 ± 7°K. The large value of γ (35 times the value of copper) apparently results from the Fermi surface intersecting narrow 5f electronic bands. The above values refer to a UN sample heat-treated in an atmosphere of nitrogen for 6.5 hr at 2250°C. The same sample, before this heat treatment, had a measured γ = 24.07 ± 0.08 mJ(g at. wt)$^{-1}$ (deg)$^{-2}$ and Θ = 322 ± 13°K. The shift in γ may be due to a small change in stoichiometry caused by the heat treatment. Although the Debye temperature obtained from the present work, 324°K, is larger than previous specific-heat estimates of 276-289°K, it is lower than the value of 364°K obtained from velocity-of-sound measurements. No changes were observed in the specific heat upon application of magnetic fields up to 35 kG, suggesting the absence of any appreciable magnetic contribution to the total specific heat for temperature below 4.7°K. (auth)

10282 CHANGES IN THE ENGINEERING PROPERTIES OF ZIRCONIUM REFRACTORIES IN RELATION TO THE DEGREE OF STABILIZATION OF ZrO_2. Klyucharov, Ya. V.; Strakhov, V. I. (Leningrad Technological Inst.). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1502-6(Sept. 1968). (In Russian).

The minimum amounts of CaO and MgO necessary for complete stabilization of ZrO_2 in the cubic modification at 1700 to 1750°C correspond to 12 and 11 mol %. On combustion of a mixture of monoclinic ZrO_2 and a cubic solid solution containing more than the minimum amounts of CaO and MgO, an additional amount of solid solution was formed. Addition of nonstabilized ZrO_2 to previously prepared cubic solid solutions containing the minimum amount of CaO or MgO promoted increased shrinkage, better sintering, and lowering of the coefficient of thermal expansion. Mechanical stability of the products was increased only on introduction of monoclinical ZrO_2 in amounts up to 20%. More thermostable compositions contain about 10% of the monoclinic phase. (tr-auth)

10283 THE THERMAL CONDUCTIVITY OF MONOCRYSTALS OF Y_2O_3, Er_2O_3, Lu_2O_3, AND Sm_2O_3. Zhuze, V. P.; Novruzov, O. N.; Popova, A. A.; Shelykh, A. I. (Inst. of Semiconductors, Leningrad. Inst. of Crystallography, Moscow. Inst. of Physics, Baku). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1493-7 (Sept. 1968). (In Russian).

Measurements were made of the thermal conductivity at 20 to 1000°C of four 150% rare earth oxides, one of which belongs to the cerium subgroup and the other three to the yttrium subgroup. All of these oxides are insulators at room temperature with a specific resistance $\rho > 10^{10}$ ohm · cm. At 1000°C their specific resistance was on the order of 10^4 ohm · cm. Thermal resistance of the oxides above room temperature was proportional to temperature. In Sm_2O_3, above 500°C there was observed additional thermal conductivity, approximately proportional to T^3, possibly connected to photon carry over. (tr-auth)

10284 SOME CHARACTERISTICS OF Ba, Sr, Na NIOBATES. Van Uitert, L. G.; Rubin, J. J.; Grodkiewicz, W. H.; Bonner, W. A. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Mater. Res. Bull., 4: 63-74(Jan. 1969).

Curie temperature (T_c) and spontaneous polarization (P_s), dielectric constant (ϵ), and voltage for half-wave retardation (V_π) of 0.6328μ radiation, all at room temperature, are given for single crystals of a Ba, Sr, Na niobate series which have tetragonal tungsten bronze-like structures. P_s is a relatively constant 0.38 ± 0.02 C/m^2 for most of the series while T_c varies between 560°C and 200°C. V_π declines approximately linearly with increasing Sr-content and the product ϵV_π tends to remain constant for poled crystals. Resistivity data are also given. (auth)

Structure and Phase Studies

Refer also to abstract 10266.

10285 COLD WORK AND RECRYSTALLIZATION SUBSTRUCTURES OF THORIA DISPERSED NICKEL COMPOSITE. Kimmel, Edward Roger. University Park, Pa., Pennsylvania State Univ., 1968. 73p.

Thesis.

Transmission electron microscopy was used to investigate the cold worked and the recrystallized substructures of TD-Nickel sheet. Substructures of the cold worked material were studied with respect to the cold worked cell size. The recrystallization behavior of the nickel thoria composite was investigated for various cold work and anneal conditions. Multiple cold work and anneal cycles were used to study the effect of recrystallization on the clustering of thoria particles in the nickel matrix. Microstructures of the cold worked TD-Nickel are characterized by a diffuse dislocation cell structure. A saturation in the hardness of the composite after 50 percent cold roll reduction is found to be accompanied by a minimum cold worked cell size. The cell size minimum appears to be governed by the mean spacing of the thoria particles. Anneal treatments produced only partial recrystallization of the cold rolled nickel thoria composite. Quantitative estimates of the percentage of recrystallized material present for each annealing condition were made in the electron microscope using over 600 viewing screen areas at 10,000 × magnification. One hour anneals at 1300°C show that increased reduction in thickness by cold rolling results in an increase in the percentage of recrystallized material. However, 80 percent cold reduction of the nickel thoria produced only 83.5 percent recrystallization. Hardness data for annealing temperatures up to 1300°C show a general decrease in hardness with temperature but no conclusive recrystallization temperature for initial cold rolling up to 80 percent reduction in thickness. Fifty percent cold rolled TD-Nickel, annealed at 1300°C, shows only 68 percent recrystallization even after 100 hours, and this degree of recrystallization does not significantly change after the first six hours. Multiple cycles of 50% cold work and 30 hour anneals at 1300°C produce an increase in the percentage of recrystallized material after the second cycle to 82.8 percent, followed by a decrease to 58.5 percent after the third cycle. Direct count of thoria particles in electron micrographs of recrystallized areas for the three cold work and anneal cycles shows a definite increase in the number of thoria particles contained in clusters as well as an increase in the number of clusters. This agglomeration of thoria particles appears to be due to sub-boundary migration during recrystallization. The sluggish recrystallization rate appears to be directly related to the manufacturing history of the starting material. The manufacturing process of multiple cold rolling with intermediate recovery anneals produces the complex dislocation cell structure observed in the starting material. This dislocation structure together with the thoria particle distribution is very effective in retarding recrystallization of the composite. Observations of partially recrystallized TD-Nickel indicate that recrystallization is also selective with respect to the original elongated grains in the cold worked material. (Disser. Abstr.)

10286 INVESTIGATION OF THE SYSTEM La_2O_3–MoO_3. Get'man, E. I.; Mokhosoev, M. V. (Donetsk State Univ., USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1554-7(Sept. 1968). (In Russian).

X-ray and thermographic analyses were carried out on the system La_2O_3–MoO_3 at 400 to 1000°C. The compounds $La_2O_3 \cdot MoO_3$, $La_2O_3 \cdot 2MoO_3$, $La_2O_3 \cdot 3MoO_3$, and $La_2O_3 \cdot 5MoO_3$ were obtained. The existence of $La_2O_3 \cdot 4MoO_3$ was established, but it could not be obtained in a pure form. Formation of these compounds proceeds in several stages. (tr-auth)

10287 THE PHASE DIAGRAM OF THE SYSTEM ZrC–Re. Ordan'yan, S. S.; Avgustinik, A. I. (Leningrad Technological Inst.). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1898-1901 (Nov. 1968). (In Russian).

The reaction between zirconium carbide and rhenium in a wide temperature range is characterized by a minimum dissolution of rhenium (<0.8 at. % at 2250°C). The system ZrC–Re is quasibinary and the phase diagram was constructed on the basis of x-ray and metallographic data. A eutectic was observed near 65 wt % Re at 2670°C. (tr-auth)

10288 THE ELECTRIC CONDUCTIVITY OF THE SYSTEM ZrO_2–La_2O_3. Volchenkova, E. S. (Inst. of Electrochemistry,

Sverdlovsk, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1875-9(Nov. 1968). (In Russian).

Ceramic properties and structure of the system $ZrO_2-La_2O_3$ sintered at 1550°C in air were determined. The electric conductivity was measured at 500 to 1000°C and the temperature coefficient calculated. It is shown that changes in electric conductivity with composition correspond to changes in structure. A minimum in electric conductivity was observed at 33.3 mol % La_2O_3, indicating the presence of the compound $La_2Zr_2O_7$ with a pyrochlore structure. (tr-auth)

10289 THE CRYSTALLIZATION CAPABILITY OF GLASSES IN THE SYSTEM B_2O_3–La_2O_3–CdO. Mukhin, E. Ya.; Shmatok, L. K. Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1938-41(Nov. 1968). (In Russian).

It was concluded that the crystallization capability of glasses in the $B_2O_3-La_2O_3-CdO$ system is very high. The temperatures of the upper boundary of crystallization vary within the limits from 900 to 1170°C. The glasses of this system lie in the region of crystallization of two compounds: lanthanum metaborate and dicadmium triborate. Compounds of the composition cadmium metaborate and tricadmium diborate are not present in the system. The glasses have refractive indices of 1.71 and 1.75 at coefficients of dispersion of 50 and 47, respectively. (tr-auth)

10290 SOLID SOLUTIONS IN THE SYSTEM $LiNd(WO_4)_2$–$Nd_2(WO_4)_3$ AND POLYMORPHIC TRANSFORMATIONS IN THE TRICLINIC MODIFICATION $LiNd(WO_4)_2$. Klevtsov, P. V.; Kharchenko, L. Yu. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1985-8(Nov. 1968). (In Russian).

X-ray and differential thermal analyses showed the formation of a continuous order of solid solutions in the system $LiNd(WO_4)_2$–$Nd_2(WO_4)_3$. Solid solutions in the range from 0 to 40.5 mole % $Nd_2(WO_4)_3$ crystallized in the scheelite structure and from 40.5 to 100 mole % in the monoclinic structure. The coefficients of linear expansion along the main crystallographic directions were calculated. X-ray analysis confirmed that, in synthesis under hydrothermal conditions, triclinic crystals of lithium neodymium tungstate are a stoichiometric compound, $LiNd(WO_4)_2$, and not a solid solution. (tr-auth)

10291 DESCRIPTION OF A Zr_3O_{1-x} SUPERSTRUCTURE. Dubertret, Alain; Lehr, Pierre (CNRS, Vitry-sur-Seine, France). Compt. Rend., Ser. C, 267: 820-2(Sept. 30, 1968). (In French).

A Zr_3O_{1-x} superstructure was observed by means of x-ray diffraction and described. The examination of the geometric positions of the atoms in the lattice showed a certain polarization of the zirconium–oxygen linkage in this superstructure. (tr-auth)

10292 CRYSTAL STRUCTURE OF CERIC AMMONIUM NITRATE. Beineke, T. A.; Delgaudio, J. (Ames Lab., Iowa). Inorg. Chem., 7: 715-21(Apr. 1968). (IS-1680).

The crystal structure of ceric ammonium nitrate, $(NH_4)_2Ce(NO_3)_6$, has been determined from three-dimensional single-crystal x-ray diffraction data collected by counter methods. The crystals are monoclinic, space group $P2_1/n$ with unit cell parameters a = 13.061 ± 0.007, b = 6.842 ± 0.004, c = 8.183 ± 0.004 Å, β = 91.34 ± 0.02°, ρ_0 = 2.49, ρ_c = 2.490 g/cm³ for Z = 2. Block-diagonal anisotropic least-squares refinement led to a conventional R of 0.036 for 625 observed reflections. The structure is composed of ammonium cations and hexanitratocerate anions. The hexanitratocerate anions result from the bidentate coordination of six nitrate groups about each cerium atom. The approximate symmetry is T_h. The average Ce–O distance is 2.508 ± 0.007 Å, the average N–O distance involving a coordinated oxygen is 1.282 ± 0.011 Å, and the average N–O distance involving a noncoordinated oxygen is 1.235 ± 0.011 Å. (auth)

10293 CHANGE IN THE CRYSTAL STRUCTURE OF MOLYBDENUM CARBIDE AS A RESULT OF THE ACTION OF HIGH PRESSURE. Koval'skii, A. E.; Timofeeva, I. I.; Rybakova, E. A. Izv. Akad. Nauk SSSR, Metal., No. 6, 232-3(Nov.-Dec. 1968). (In Russian).

From the action of high pressures and temperatures, a new phase of molybdenum carbide, not corresponding to any of the known structures of molybdenum carbide, was found. The phase is characterized by high stability; the structure was kept after annealing at 2000°C. The pressure used in the experiment was about 70 kbar and the temperature ~1400°C. (tr-auth)

10294 METHOD FOR DETERMINING THE MICROSTRUCTURAL CHANGES IN GRAPHITE THAT ACCOMPANY HIGH TEMPERATURE DEFORMATION. Green, W. V.; Levinson, L. S.; Reiswig, R. D.; Zukas, E. G. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-Eng-36. Carbon, 5: 583-6(1967). (LA-DC-8622).

Sequential optical and electron photomicrographs were made on the same areas of graphite specimens before and after various amounts of creep strain at 2500°C. The polished and etched surfaces of the specimen were preserved by wrapping several layers of pyrocarbon tape over the gage length, by outgassing at temperatures below 2000°C in a vacuum of less than 5×10^{-5} torr, and by using spectrograde argon when heating to temperatures above 2000°C. The strains for ZTA samples whose stress axes were parallel, or nearly parallel, to the average c-axis were caused principally by crack formation and growth. (auth)

Radiation Effects

Refer also to abstracts 10699, 11351, and 11355.

10295 (BAW-3809-5) POSTIRRADIATION EXAMINATION OF THORIA–URANIA FUEL RODS. Quarterly Progress Report No. 5, June–August 1968. Bishop, W. N.; Baroch, C. J. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Dec. 1968. Contracts AT(30-1)-3809; 859-3103. 28p. Dep. CFSTI.

Mass spectrometric determinations of the isotopic compositions of uranium and plutonium have been completed. Data for the peak burnup zone of several rods are compared with the calculated abundances. Profilometer measurements of the fuel cladding, metallographic examinations of the fuel and the cladding, and preparation of the tensile specimens were completed. Tensile testing of the unirradiated stainless steel specimens was completed. (auth)

10296 (BNWL-SA-1969) HIGH BURNUP PLUTONIUM OXIDE IRRADIATIONS. Christensen, J. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1, 1968. Contract AT(45-1)-1830. 11p. (CONF-681101-7). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

Bulk PuO_2 and Pu_2O_3 were irradiated to greater than 50% burnup in the MTR. Post irradiation examination consisted of metallography, audiography, and x-ray diffraction analysis. Results showed slight effects on crystal structure and the ability of the oxide to creep extensively at low temperature. The oxides reacted slightly with the Al cladding. No nonuniformities in Pu or fission fragment concentration were observed. (F.S.)

10297 (KAPL-M-6919) FISSION DAMAGE IN SOLID FUELS, MAINLY UO_2: A CRITICAL SURVEY. PART 1. ATOMIC AND STATISTICAL DAMAGE MECHANISMS. Bobone, Renato (Knolls Atomic Power Lab., Schenectady, N. Y.). June 1968. Contract W-31-109-eng-52. 122p. Dep. CFSTI.

Complex problems of engineering behavior and of design of solid nuclear fuels arise because of in-pile radiation damage. The mechanical behavior of a solid fuel, in particular UO_2, is determined by the way in which a very large number of fission events affects its lattice structure under given operating conditions of neutron flux, temperature, and external pressure. Most damage is caused by the two or occasionally three fragments generated by each fission event. The fate of two fission fragments is followed from the instant of fission to their coming to rest in the lattice of the solid. These fragments, which are highly ionized as well as highly energetic at the beginning of their flights, at first lose energy mostly by ionized lattice atoms and then, as they become neutral atoms, by colliding with the atomic nuclei of the lattice. Atoms of the solid may or may not be displaced along the ionization range, depending on the electrical and mechanical properties of the solid fuel. Displacements and the accompanying vacancies do occur along the collision range. Cumulative effects of a very large number of fissions are considered. The diffusion of the noble gases Xe and Kr and their isotopes is described. At some level of integrated flux these gases begin to nucleate and form microbubbles, which migrate throughout the lattice, driven by random forces as well as by directed forces such as temperature and stress gradients. Colliding bubbles coalesce and grow or they may generate dislocations. Solid fission products also accumulate and segregate. Most of the theories are reviewed and are applied to all solids. These have been consistently applied to UO_2 by making use of the information on the physical properties of this compound. This survey provides a foundation for understanding and for solving the problems of in-pile behavior of fuels e.g., the in-pile creep of UO_2. (auth)

10298 (NUMEC-3432-41) IRRADIATION TESTING OF PuO_2–UO_2 FUELS. 14th Quarterly Report, October–December 1967. (Nuclear Materials and Equipment Corp., Leechburg, Pa. Plutonium Lab.). Apr. 1968. Contract AT(30-1)-3432. 13p. Dep. CFSTI.

Three pellet type fuel elements were irradiated to a nominal

burnup of 60,000 MWd/t in GETR. Fuel elements consist of 0.20 inch diameter centerless ground pellets clad in 19 mil wall type 316L stainless steel. As-loaded parameters of these fuels are tabulated. Calculated peak thermal rating of these fuels was 320 to 350 watts/cm with centerline temperatures of 2000 to 2100°C. Metallographic examination of the fuel containing 20 wt % PuO_2–UO_2 substoichiometric coprecipitated and stoichiometric mechanically blended fuels was completed. Metallography of the mechanically blended substoichiometric fuel was previously reported. Transverse sections of the fuel were mounted in copper-bakelite moulds, ground, polished and cathodic vacuum etched. (auth)

10299 IRRADIATION BEHAVIOR OF URANIUM–PLUTONIUM CARBIDE FUELS. Frost, B. R. T. (Atomic Energy Research Establishment, Harwell, Eng.); Horspool, J. M.; Bellamy, R. G. Nucl. Met., Met. Soc. AIME, 13: 490-506(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Studies of the irradiation behavior of (U,Pu)C under conditions typical of those in a sodium-cooled fast breeder reactor have been made. With the fuel element geometry typical of oxide fuels carbide displays a high retention of fission gases and a high swelling rate, leading to early clad failure. The experiments suggest that operation below 1000°C, as in a sodium bonded design, operation at very high fuel temperatures, or the use of a single size fraction powder may lead to improved performance from carbide fuel in a sodium cooled fast reactor. (auth)

10300 U.S. EXPERIENCE ON IRRADIATION PERFORMANCE OF UO_2–PuO_2 FAST REACTOR FUEL. Skavdahl, R. E.; Spalaris, C. N.; Zebroski, E. L. (General Electric Co., Sunnyvale, Calif.). Nucl. Met., Met. Soc. AIME, 13: 439-59(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

High-burnup specimens examined include thermal flux samples at high burnup (>10 atom %) and fast flux specimens at medium burnup (~6 atom %). Detailed analysis of fuel pins irradiated to burnups up to 6.3 atom % in fast flux, generally confirm the low swelling rates observed in thermal flux. The largest diametral strain was associated with strong axial restraint. Thermal reactor irradiations of vented-to-coolant fuel pins demonstrated an effective holdup time of several days for fission gas release with a simple one-stage vent. Vented fuel is believed to have promise for significantly lengthening fuel lifetime. Transient irradiations show no fuel damage occurs with or without pre-irradiation until energy inputs sufficient to melt about half of the fuel are reached. (auth)

10301 BELGIAN EXPERIENCE IN FABRICATION AND IRRADIATION PERFORMANCE OF FAST REACTOR FUEL (UO_2–PuO_2). Leblanc, J. M.; Horne, R. (BelgoNucleaire, Brussels). Nucl. Met., Met. Soc. AIME, 13: 418-38(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

A description of three fast reactor fuel pins developed includes conventional pelleted fuel pins, collapsed clad fuel pins, and vibratory compacted fuel pins. The specifications of the three types of fuel pins and the fabrication flowsheets are given. Parameters related to low density fabrication are discussed. Irradiation tests on fast reactor fuel pins will be achieved in the Enrico Fermi fast reactor, the Dounreay fast reactor, and the BR2 reactor. Irradiation parameters have to be evaluated. (auth)

10302 IRRADIATION OF PLUTONIUM FUELS IN THE BR-3. Bairiot, H.; Lhost, A. (BelgoNucleaire, Brussels). Nucl. Met., Met. Soc. AIME, 13: 146-73(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Fuels that have been tested in the BR-3 reactor are described. Pelletized uranium fuel is compared with vibratory compacted and swaged plutonium fuels. Different types of UO_2 have been utilized for the powders. The burnup has been of the order of 5,000 MWd/t. The main result concerns the gas release by heterogeneous particulate fuels compared with pellets and the effect of the UO_2 powder used as starting material. The BR-3/Vulcain experiment will allow comparison at high burnups (30,000 MWd/t) of vibratory compacted and pelletized plutonium fuels. In this experiment, it has already been possible to evaluate some very important details concerning a simplified technique utilized for the manufacture of the plutonium fuels. (auth)

10303 OPERATING EXPERIENCE WITH THE SAXTON REACTOR PARTIAL PLUTONIUM CORE II. Miller, R. S.; Roll, J. B.; Jordan, K. R.; Rolin, J. L.; Kubit, C. J. (Westinghouse Electric Corp., Pittsburgh). Nucl. Met., Met. Soc. AIME, 13: 129-45(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

Operation of the Saxton Reactor with nine central fuel assemblies containing 6.6 wt % PuO_2 in natural UO_2 and clad with Zircaloy-4 was started and continues presently. Observed nuclear, thermal-hydraulic, and fuel materials performance have agreed very well with the performance predicted during the design phase. The results of the post-irradiation examination and evaluation of two pellet and two vipac fuel rods, removed from the central 3 × 3 subassembly at a peak burnup of 6100 MWd/mtm, are discussed. (auth)

10304 FRENCH IRRADIATION EXPERIENCE WITH MIXED OXIDE FUELS FOR FAST-REACTOR APPLICATION. Mustelier, J. P. (EURATOM-CEA, Fontenay-aux-Roses, France). Nucl. Met., Met. Soc. AIME, 13: 382-95(1968).

From the Nuclear Metallurgy Conference, Phoenix, Ariz. See CONF-671005.

An irradiation program of UO_2–PuO_2 mixed oxides has been performed in the thermal reactor EL 3 in order to design the Rapsodie fuel element. Post-irradiation examinations have shown that the design of the fuel element was realistic. The reactor Rapsodie was raised to nominal power and an examination program on complete subassemblies was initiated. To design and test the reference fuel of the power fast reactor Phenix, an irradiation program in both fast and thermal flux was initiated. (auth)

10305 NUCLEAR RADIATION EFFECTS ON STRUCTURAL AND PHYSICAL CHANGES IN GLASS. Plisko, T. A.; Sil'vestrovich, S. I.; Vasil'ev, G. Ya. (Moscow Inst. of Chemical Tech.). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 2175-9(Dec. 1968). (In Russian).

Radiation effects on physical-structural changes of glass were studied with specimens irradiated at room temperature using ^{60}Co γ-rays; 40,000 g-equiv radium at doses from 0.4 to 386.4 Mrad; and at neutron flux densities from 10^{13} to 10^{18} n/cm² at 20°C. It was shown that with the increased amount of absorption energy there was a tendency of developing capture centers related to electron localization in silicon. (R.V.J.)

10306 ANNEALING OF GRAPHITE IRRADIATED WITH ELECTRONS AT 80°K. Davies, C. B.; Mitchell, E. W. J. (Univ. of Reading, Eng.). Phil. Mag., 19: 57-83(Jan. 1969).

After fast-electron irradiation at 80°K graphite exhibits, in its electrical resistivity during isochronal annealing, a reverse stage followed by normal stages. These constitute the Austerman and Hove (1955) peak. The reverse stage was previously attributed to the separation of close Frenkel pairs of defects. The height of the peak was measured as a function of bombarding electron energy between 0.4 and 2.0 MeV, and the peak was studied by measuring changes of electrical resistance of reactor grade A polycrystalline graphite. The measured peak height was approximately constant for electron energies from 2.0 MeV to just below 1.0 MeV, with a tendency to decrease as the electron energy decreased below 1.0 to 0.4 MeV. A method of analysis of the peak height in terms of the fraction (f_{iv}) of close Frenkel pairs is given, but from estimates of the energy dependence of f_{iv} based on the theory of radiation damage it was not possible to account for the observed results. Other models are considered and analyzed in a similar way. While it is not possible to provide a unique explanation, it is concluded that the reverse stage must arise from the enhancement, rather than the diminution, of the number of close Frenkel pairs. The most likely model is one in which the free interstitial is mobile at ca. 90°K (energy of motion about 0.3 eV). (auth) (UK)

10307 RADIATION DAMAGE STRESSES IN THE GRAPHITE OF POWER-PRODUCING NUCLEAR REACTORS. Heal, J. L. (Imperial Coll. of Science and Tech., London); Sockalingam, K. C. J. Mech. Eng. Sci., 10: 402-11(Dec. 1968).

A method for predicting the stresses developing in the graphite blocks due to differential dimensional changes is presented. Allowance is made for relaxation by irradiation creep. (UK)

Plastics and Other Materials

Refer also to abstracts 9673, 11232, 11235, and 11248.

10308 (BNWL–919, pp 3.1-19) NUCLEAR GRAPHITE. Nightingale, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Spherical, shell-like arrangements of graphite crystallites, appearing as rosette structures, have been found in binder regions of TSX and AGOT graphite. Rosette structures occur singly, as fused

duplex arrangements, and in various kinds of clusters of three or more units. Electron diffraction data confirm the spherical symmetry of rosette structures and indicate that they are surrounded by smaller less orderly crystallites than those within the rosettes. Oxidation experiments indicate that rosettes are quite resistant to attack by thermal reaction but are easily consumed by microwave-excited oxygen. Various stages in the development of cone structures and impurity networks have been examined in TSX and AGOT graphite oxidized by microwave-excited oxygen After 5% burnup, cone heights range from 100 to 5000 Å, and the size distribution does not appear to change with burnup level up to at least 30%. (auth)

10309 (CEA-CONF-1091) NEW TYPES OF CONCRETE RESISTENT TO HIGH TEMPERATURES FOR THE PROTECTION OF NUCLEAR REACTORS. Dubois, F.; Mauny, P.; Rappeneau, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 40p. (In French). (CONF-681008-2). Dep.

From Symposium on Advanced and High Temperature Gas-Cooled Reactors, Juelich, Germany.

The development of high temperature concretes, for use in reactor containment vessels, is discussed. The chemical, thermal, and mechanical properties of the binders used in these concretes are detailed; the aggregates and their uses are outlined. Thermal properties of the concrete are discussed. Effects of temperature and radiation are tabulated for different concrete binders. Effects of pressure, temperature, and radiation are analyzed. Physical and mechanical properties are tabulated. All data are given in tabular form. (M.L.S.)

10310 (ORO-2418-6) INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION. Research Report for 1968. Sears, W. C. (Georgia Univ., Athens. Dept. of Physics). Dec. 20, 1968. Contract AT(40-1)-2418. 17p. Dep. CFSTI.

Since molar absorptivity for the trans-vinylene band in trans-1,4-polybutadiene was found to decrease as its temperature increases, several temperature cycles on new samples of this polymer and one on cis-1,4-polybutadiene have been carried out. Trans-1,4-polybutadiene, on being melted before spectral scanning, continued to show a change of crystallinity from modification I to II at 57 to 58°C instead of 76°C as was previously determined. A change in slope of the molar absorptivity curve versus temperature curve for the trans polymer was observed at 76°C, but no rapid drop in molar absorptivity or integrated intensity was found near the melting point at 145°C. This effect is attributed to rapid cooling which apparently kept the polymer amorphous. Resolution of recorded polymer spectra into component bands is being done by a computer to get a more accurate measure of band intensities prior to analysis calculations. Curves of experimental and fitted data (both composite and component curves) are included to illustrate the results. (auth)

10311 THE PROPERTIES AND TESTING OF PLASTICS MATERIALS. THIRD EDITION. Lever, Arnold Eric; Rhys, Jack Aubrey. Feltham, Eng., Temple Press, 1968. 455p. 63s.

Ten chapters are included in the book. An abstract was prepared for one section in chapter one. Chapters and sections for which no abstracts were prepared are concerned with physical, thermal, optical, chemical, and electric properties. Information is also included on identification and analysis, industrial materials, testing and plasticizers. (J.R.D.)

For an abstract of the individual section see: 10312.

10312 IRRADIATION. pp 19-30 of The Properties and Testing of Plastics Materials. Lever, Arnold Eric; Rhys, Jack Aubrey. Feltham, Eng., Temple Press, 1968.

Radiation effects on plastics materials of elastomers, ethylene polymers, laminates, polymethyl methacrylate, polytetrafluoroethylene, rubber, rubber-modified polystyrene, resins, and teflon are summarized. Dosages and environmental factors applicable to nuclear uses are discussed. A listing of 143 references is given. (J.C.W.)

10313 TIME, TEMPERATURE, CREEP, AND SHRINKAGE IN CONCRETE. Moncrieff, M. L. A.; Waggott, J. G. (Imperial Coll. of Science and Tech., London). pp 123-30 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A computer program developed to evaluate the effects of creep and shrinkage on heated concrete is described. The structure considered is a column that is free to expand axially but constrained to remain vertical. The structure may be subjected both to axial loads and to heating on one face; the loads and heating rates can be varied in any number of discrete steps singly or in combination. This simple model has many features in common with a spherical pressure vessel so that, by a suitable choice of loading sequence, the behavior of a vessel throughout its life can, in a general way, be investigated. A theoretical assessment of the behavior of vessels covering a practical range of sizes and concrete strengths is presented. (auth) (UK)

10314 PROPERTIES OF CONCRETE IN REACTOR VESSELS. Browne, R. D. (Taylor Woodrow Construction Ltd., London). pp 131-51 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The concrete properties of interest in reactor vessel design, including compression strength, creep, shrinkage, thermal expansion, and thermal conductivity, are examined with reference to vessel conditions. The effects of radiation, age, temperature, and humidity are considered. Details are also given of the concrete test program carried out for the Wylfa nuclear power station; this was done in order to reduce the range of property estimates based on the available literature, and to understand more clearly the behavior of a particular property under simulated vessel conditions. The results are given of the large number of tests made on the effects of temperatures from 68 to 200°F, and of age, on the elastic and creep deformation behavior under load of the actual limestone concrete used for the Wylfa vessels. (85 references) (UK)

10315 CREEP IN PRESSURE VESSELS AT ELEVATED TEMPERATURES. Barrett, N. T.; Murray, J. T. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). pp 153-66 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Evidence in the literature on the effect of stress changes on the creep of concrete is supplemented by the results of new experiments on creep at constant load and constant elevated temperature, and the results of a few experiments in which temperature increments and decrements were imposed on loaded specimens. A simplified hypothesis of creep behavior is described and from it an approximate method of calculating creep strains due to changes in stress and temperature is developed. The method is used to predict the behavior of a model spherical prestressed concrete pressure vessel subjected to cable loading and a history of temperature increments and decrements. (UK)

10316 CONCRETE PROPERTIES AFFECTING THE INTEGRITY OF PRESSURE VESSELS. Davies, I. Ll. (United Kingdom Atomic Energy Authority, Foulness, Eng.); Davidson, I. pp 167-71 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The reasons for carrying out a series of experiments into the failure behavior of prestressed concrete pressure vessels is explained. A discussion of a simple analysis of ultimate pressure-carrying capacity based on mechanism equilibrium is used to justify the choice of experiments, and a brief description is given of their nature. (UK)

10317 STRAIN BEHAVIOUR OF CONCRETE UP TO 95°C UNDER COMPRESSIVE STRESSES. Hannant, D. J. (Central Electricity Research Labs., Leatherhead, Eng.). pp 177-91 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A description is given of the strain behavior, both elastic and creep, of a particular concrete under various uniaxial and multiaxial compressive stress combinations at temperatures between 27°C and 95°C for periods of loading up to 2 yr. Creep strains under long-term loading at the highest temperatures are shown to be several times greater than at 27°C and the effect of temperature on the elastic Young's modulus is shown to be dependent on the length of the heating cycle. Predictions are made for creep strains under uniaxial stress during a 20 yr loading period at constant moisture content for temperatures up to 77°C. The effect of the moisture content of the concrete on the strain behavior is discussed. Creep strains under multiaxial stress conditions are compared with those normally used in design, i.e., uniaxial values, and modifications to the uniaxial data are suggested for use in prestressed concrete pressure vessel design in positions where biaxial and triaxial stresses occur. This involves the use of a Poisson's ratio for creep. (auth) (UK)

10318 LONG-TERM COMPRESSIVE STRENGTH OF CONCRETE. Glucklich, J. (Israel Inst. of Tech., Haifa). pp 193-8 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

It is suggested that a specimen under a sustained compressive load undergoes two phases before it eventually fails. First, the elastic energy content increases exponentially with time due to a delayed elastic mechanism. During this phase the material exhibits a regular creep behavior which, however, also includes slow and controlled microcracking. When the energy attains such a level that its release rate (crack-length rate) reaches a certain critical value, the second phase sets in. At this phase the slow controlled cracking becomes fast and spontaneous leading to total fracture. The onset of the second phase is considered representing the true strength of the material. It is manifested by a point of inflection on the creep curve. The specimen can sustain loads beyond this event only because it is not reached simultaneously for all points of the material and because compression cracks develop parallel to the stress and friction holds the pieces together. In tension this event coincides with fracture. In order to formulate a relationship between the long- and short-term technical strengths, it is recommended to proceed in two steps: first, determination of this relationship for the true strengths through consideration of the viscoelastic properties; second, separate study of the excess of the technical over the true strength in the short-term test. This strength increment is a function of test conditions. (auth) (UK)

10319 IRRADIATION EFFECTS ON CONCRETE. Kelly, B. T. (United Kingdom Atomic Energy Authority, Culcheth, Eng.); Davidson, I. pp 173-5 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Existing experimental evidence on the effect of irradiation on concrete does not fully cover the higher doses, and the higher strength concretes, appropriate to prestressed concrete reactor pressure vessels. New experiments are being conducted and these are described. (auth) (UK)

10320 PARAMAGNETIC RESONANCE ABSORPTION IN ANNEALING PROCESS OF RADIATION-DAMAGED GRAPHITE. Yugo, Shigemi; Tsuzuku, Takuro (Nihon Univ., Tokyo). Tanso, No. 55, 121-3(Dec. 1968). (In Japanese).

An ESR study was made of the isothermal annealing of radiation damage in a reactor grade polycrystalline graphite after fast neutron bombardment at room temperature to total dose of 5.8×10^{20} nvt. The absorption found for the specimens annealed below 950°C is concluded to be due to the unpaired electrons which are localized to the radiation-induced defects. For specimens annealed above 1450°C, the Pauli-McClure type paramagnetism due to conduction carriers, takes part in ESR, while the localized spin centers still participate to some extent. In the annealing range between 1000°C and 1400°C no absorption signals were observed, which is likely due not to the complete extinction of spin species but to the extreme broadening of line originating from some structural reasons. (NSA of Japan)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstract 10483.

Stars

10321 (LA–4048) RADIATIVE TRANSFER EFFECTS IN CEPHEID ATMOSPHERES. Davis, C. G. Jr.; Bendt, J. (Los Alamos Scientific Lab., N. Mex.). Nov. 10, 1968. Contract W-7405-eng-36. 7p. Dep. CFSTI.

The diffusion approximations, used in nonlinear Cepheid pulsation calculations, were studied with a moments expansion method of the radiative transfer equation. The use of the diffusion approximation (gray case) does not introduce errors in the model (7 $M_\odot$ Baker–Kippenhahn) studied. A frequency dependent result, for this model, gives velocity and luminosity profiles in general agreement with the diffusion results. The continuum spectral characteristics are given. (auth)

10322 STELLAR KINEMATICS. Smart, W. M. New York, John Wiley and Sons Inc., 1968. 326p. $12.50.

The principal objects of the book are to present all the necessary formulae for the calculations and to provide the mathematical basis for all the problems that arise in stellar kinematics. It also supplies the necessary kinematical foundations for the highly-developed dynamical, and to some extent cosmological, theories, the principal investigations in this context being the systematic motions of the stars and the rotation of the Galaxy, and the numerical evaluation of the period–luminosity relationship of Cepheid variables. Among other aspects of stellar kinematics fully discussed are the important topic of deriving corrections to Newcomb's precessional constants, the methods by which the average distances of groups of stars may be calculated, deductions relating to stellar distances and the interstellar cloud. Kapteyn's theory of two oppositely-moving star streams and its alternative, Schwarzschild's ellipsoidal hypothesis, are fully examined and applied to the observations and calculations described. (W.D.M.)

10323 OUTER CONVECTION ZONES AND INTERNAL TEMPERATURES OF COOL WHITE DWARFS. Boehm, Karl-Heinz (Univ. of Washington, Seattle). Astrophys. Space Sci., 2: 375-83 (Nov. 1968).

The outer convection zone of the low-temperature white dwarf Van Maanen 2 was studied for two different atmospheric models given by Weidemann (1960). A slight modification of the standard mixing length theory and the abundances derived by Weidemann were used. The thickness of the convection zone is about 8 km for the atmospheric model with $T_{eff} = 5780$ K, $g = 10^8$ cm sec^{-2} and about 23 km for $T_{eff} = 5040$, $g = 3.16 \times 10^7$K. In both cases the temperature at the lower boundary of the convection zone is about 9.8×10^5K. It is shown that this temperature corresponds approximately to the transition temperature T_u to the (almost) isothermal core of the white dwarf. This value is considerably lower than the values of T_u discussed in the literature until now. The outer convection zone consists of an upper completely nondegenerate part and a lower part with moderate degeneracy. In this lower part the degree of degeneracy is practically independent of depth. (auth)

10324 INFLUENCE OF VARIABLE INITIAL COMPOSITION ON STELLAR SILICON BURNING. Truran, James W. (Yeshiva Univ., New York). Astrophys. Space Sci., 2: 384-90 (Nov. 1968).

Silicon burning at a temperature $T = 3 \times 10^9$ K was studied for three initial abundance configurations: (1) $X(^{28}Si) = 1$; (2) $X(^{28}Si) = X(^{24}Mg) = 0.5$; and (3) $X(^{28}Si) = X(^{32}S) = 0.5$. It may be observed that, in the absence of beta-decay, the results obtained for cases (2) and (3), in which admixtures of substantial mass fractions of ^{24}Mg and ^{32}S into a silicon region are considered, will converge toward those of the pure silicon relaxation problem. This convergence takes place on a rapid time scale for the ^{24}Mg admixture while, in the case of a ^{32}S admixture, the abundances of the heavy elements ($A > 28$) are enhanced for a substantial fraction of the lifetime of the silicon burning process. (auth)

10325 A NUMERICAL TEST OF THE QUASI-EQUILIBRIUM APPROXIMATION FOR STELLAR SILICON BURNING. Truran, James W. (Yeshiva Univ., New York). Astrophys. Space Sci., 2: 391-9 (Nov. 1968).

A measure of the range of the validity of the nuclear quasi-equilibrium approximation, employed by Bodansky, Clayton, and Fowler (1968) for the treatment of stellar silicon burning, is obtained by comparison of the predicted abundances with the results of a numerical solution of the equations for the time rates of change of the nuclear abundances. The results of these calculations, performed for a temperature $T = 3 \times 10^9$ K, are compared with those obtained by Bodansky et al., for a temperature $T = 5 \times 10^9$ K. The time required for the realization of the quasi-equilibrium condition at high temperatures is found to comprise a more substantial fraction of the silicon burning lifetime. This behavior is found to be attributable to the relative temperature sensitivities of the nuclear photodisintegration rates which determine the silicon burning lifetime and the charged particle reaction rates (largely $^{44}Ti(\alpha,p)^{47}V$) which determine the rate of buildup of iron peak nuclei. (auth)

10326 PREDICTED FORBIDDEN LINE SPECTRUM OF Ni IV. Garstang, R. H. (Univ. of Colorado, Boulder). Astrophys. Space Sci., 2: 336-43 (Nov. 1968).

The spectrum of RR Telescopii in 1954 had a number of strong unidentified lines. To examine the possibility of some of these being due to Ni IV the energies of the $3d^7$ configuration of this ion were calculated. Estimates of the quantum-mechanical parameters were made by extrapolation from known ions. Transition probabilities were computed for magnetic dipole and electric quadrupole radiation for all possible transitions within the $3d^7$ configuration. Several predicted forbidden lines are in the region of unidentified lines in RR Telescopii; calculated energies are insufficiently accurate for definitive identifications to be made, but further laboratory work might lead to several identifications. (auth)

10327 THE SUPERGIANT HD 33579. Wares, Gordon W. (Air Force Cambridge Research Labs., Mass.); Ross, John E.; Aller, Lawrence H. Astrophys. Space Sci., 2: 344-51 (Nov. 1968).

The brightest star in either Magellanic cloud has been analyzed by the method of model atmospheres using observational data secured at Cerro Tololo. The results from abundance studies are in general accord with the conclusions by Przybylski. Solar abundances were found for Fe, Sc, Mg, Si, and probably, Ca. The V, Cr, Si, Ti data suggest lower abundances but the evidence is not conclusive. (auth)

10328 ON THE SPECTRUM OF A GASEOUS NEBULA OF PURE HYDROGEN. I. Gerola, H.; Panagia, N. (Laboratorio di Astrofisica, Rome). Astrophys. Space Sci., 2: 285-301 (Nov. 1968).

The emissivity for the two-photon decay from the metastable level 2s was computed in the case of a gaseous nebula of pure hydrogen, with both radiative and collisional excitation of the states. The populations of 2s and 2p levels are deduced from the condition of equilibrium with other levels. Electron temperatures between 10^4 and 4×10^4 K and electron densities between 10^4 and 10^6 cm^{-3} were investigated. For the optically thin case Ly α intensity was also computed. In the case of collisional excitation a much greater efficiency for the two-photons process was found, which profoundly affects the appearance of the continuous spectrum. (auth)

10329 ON THE RELATION BETWEEN THE AMPLITUDE OF LIGHT AND RADIAL VELOCITY VARIATIONS OF β CANIS MAJORIS STARS. Leung, Kam-ching (Inst. for Space Studies, New York). Astrophys. Space Sci., 2: 302-6 (Nov. 1968).

The relation between the amplitude of light Δm and the amplitude of the radial velocity 2K for β Canis Majoris stars was investigated. A linear relationship between Δm and 2K was found. However, the two stars BW Vul and σ Sco, which have the largest radial velocity variations, do not seem to share this relationship. (auth)

10330 ON THE STRATIFICATION OF ELEMENTS IN THE ATMOSPHERES OF GLOBULAR CLUSTER AND HALO B-STARS. Castellani, V.; Renzini, A. (Univ., Rome). Astrophys. Space Sci., 2: 307-9 (Nov. 1968).

A theoretical check was performed to determine for the horizontal-branch stars the zone (in the H–R diagram) in which the surface convection is acting. A possible experimental test of the efficiency of the depletion mechanism is proposed. (auth)

10331 EVOLUTION OF THE HORIZONTAL BRANCH STARS OF METAL-POOR GLOBULAR CLUSTERS. Castellani, V.; Renzini, A. (Univ., Rome). Astrophys. Space Sci., 2: 310-14 (Nov. 1968).

The actual knowledge on horizontal branch stars of the metal-poor globular clusters of the Galaxy suggests that these stars evolve along the horizontal branch from the very blue stars towards lower effective temperature. From this behavior it follows that a substantial mass loss occurs at the He flash. On the basis of a gravitational thermalization of horizontal branch stars, recent observational data concerning NGC 7006 are re-examined. It is pointed out that today it is not necessary to leave the hypothesis of a strong correlation between the metal and helium content for the Galaxy. (auth)

10332 NOTE ON THE ANALYSIS OF LIGHT CURVES OF ECLIPSING BINARIES WITH DISSIMILAR COMPONENTS. Walter, Kurt (Univ. of Tuebingen, Ger.). Astrophys. Space Sci., 2: 315-18(Nov. 1968).

The term Δl_{per} giving a correction needed to reduce the light curves of eclipsing binaries with dissimilar components to those of rectifiable models with similar components is discussed in view of a practical definition of the luminosities of the components. A new form of the term is proposed. Furthermore, a way is shown for applying this term also when the light curve has already been rectified in the usual manner. (auth)

10333 EXPANDING ATMOSPHERES IN OB SUPERGIANTS. II. Hutchings, J. B. (Univ. of Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc., 141: 329-48(1968).

A general approach to the problem of computing strong line profiles in hot extended stellar atmospheres is described. Using velocity-height relations derived in Paper I (Mon. Notic. Roy. Astron. Soc., 141: 219(1968)) of this series for the atmospheres of stars HD 152236, 152408, and 151804, atmospheric models were built up by comparing observed and computed line profiles. A similar procedure was applied to HD 5394 using recently measured Hγ profiles. (auth) (UK)

10334 STARS OF HIGHER MULTIPLICITY. Evans, David S. Quart. J. Roy. Astron. Soc., 9: 388-400(Dec. 1968).

Star clusters are characterized by large numerical membership and relatively weak gravitational binding. Binary stars are characterized by a small numerical membership (two), and strong gravitational binding. It is suggested that these two kinds of stellar aggregates represent the two ends of a sequence, and that between them a range of stellar systems of moderate membership, with high gravitational binding, is to be found. Answers to some of the questions arising from this idea are discussed. (UK)

10335 THE DISSOCIATION EQUILIBRIUM OF H^- IN STELLAR ATMOSPHERES. Lambert, D. L.; Pagel, B. E. J. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc., 141: 299-315(1968).

The assumption that the source function for continuous thermal radiation arising from H^- in solar-type stellar atmospheres is adequately represented by the Planck function has previously been justified on the grounds that the dissociation equilibrium of the H^- ion is governed by the associative detachment reaction $H^- + H \rightarrow H_2 + e$. This argument is re-examined in the light of recent theoretical and laboratory data on the rates of the relevant processes, taking into account (schematically) the presence of separate vibrational and rotational levels of the H_2 molecule. The earlier conclusions are confirmed for the photospheres of main-sequence stars and of normal giants (at any rate for those giants in the range of spectral type G_5 III to K_5 III) and they are shown to be consistent with observed infrared colour indices. A rise of temperature caused by departures from LTE in the solar chromosphere is found to be rather unlikely, though not altogether impossible, in view of plausible estimates of the relevant atomic parameters. (auth) (UK)

10336 ATOMIC OSCILLATOR STRENGTHS. V. CIV, NV, OVI, AND SIIV. Warner, Brian (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc., 141: 273-6(1968).

Absolute oscillator strengths are given for a number of important transitions in the ions C(IV), N(V), O(VI), and Si(IV). Scaled Thomas-Fermi wave functions were used throughout. There is excellent agreement with results obtained from analytic self-consistent field calculations. (auth) (UK)

10337 NONCOHERENT SCATTERING. IV. DOPPLER REDISTRIBUTION FUNCTIONS IN MOVING ATMOSPHERES. Hummer, D. G. (Joint Inst. for Lab., Astrophysics, Boulder, Colo). Mon. Notic. Roy. Astron. Soc., 141: 479-88(1968).

Redistribution functions and their directional averages are derived for scattering by an assembly of atoms possessing a Maxwellian distribution in a frame moving with respect to the observer. Various assumptions concerning the form of the absorption coefficient and the coherence properties in the atom's rest frame are considered. The exact redistribution function for pure Doppler broadening is expanded in Legendre polynomials to facilitate evaluation of the source function. From the expansion it is clear that the use of direction-averaged redistribution functions will be significantly less accurate for moving than for static media. (auth) (UK)

10338 HOENL-LONDON FACTORS FOR $^3\phi - ^3\Delta$ SYSTEMS. Tatum, J. B. (Radley Coll., Abingdon, Eng.). Mon. Notic. Roy. Astron. Soc., 141: 459-67(1968).

In M and S type stars the strongest absorptions often result from $^3\Phi - ^3\Delta$ band systems of TiO and ZrO. The relative strengths of the various branches in these bands depend on quantities known as Hönl-London factors. These factors are necessary in order to estimate the rotational temperature of the molecules in the atmospheres of M and S stars. They may also be useful in the detection of the isotopes of titanium and zirconium. Hönl-London factors are given for $^3\Phi - ^3\Delta$ and $^3\Delta - ^3\Phi$ systems. Three coupling cases are considered: (i) both states are intermediate between Hund's cases (a) and (b); (ii) both states are case (a); and (iii) both states are case b. (auth) (UK)

10339 THE RELATION BETWEEN (B-V) COLOR AND RADIATION TEMPERATURE DEDUCED FROM ECLIPSING VARIABLES. Svolopoulos, Sotirios N. (Univ., Ioannina, Greece). Z. Astrophys., 69: 296-310(1968).

An empirical relation between (B-V) color and radiation temperature was found from the observational data of eclipsing variables undergoing total eclipses. The relation is compared with the empirical relation between color temperature and radiation temperature, found from similar data and in a fundamentally comparative way by Becker (1948). (auth)

10340 REVISION OF THE RGU PHOTOMETRIC SYSTEM. Steinlin, Uli W. (Univ., Basel). Z. Astrophys., 69: 276-95 (1968). (In German).

The applications of the RGU System will depend for still some time to come on conversions of UBV standard magnitudes. New transformation equations for main sequence stars are empirically derived to replace the former unsatisfactory conversions. The revision of the fundamental data of RGU photometry yields improvements in two points: a) position of the main sequence curve for spectral types O to B5 based on a revised photometry of open clusters with unevolved stars of these types; b) a distinction between zero age main sequence and mean luminosity class V which has been missing so far. The data used up to now coincide more or less with those for mean luminosity class V. According to the zeropoint definition of the RGU-System, for which U-G = G-R = 0.00 holds for B0 stars, A0 stars have after the new reduction the color indices U-G = 1.24 and G-R = 0.32. For stars with interstellar reddening modified transformation equations are derived first for the commonly used coefficient for the ratio between reddening and total absorption and between the different color excesses, and then also in a more general form for any law of interstellar extinction. (auth)

10341 NUMERICAL CALCULATION OF THE INTENSITY FOR A GIVEN SOURCE FUNCTION. Kaehler, Helmuth (Hamburger Sternwarte, Hamburg). Z. Astrophys., 69: 273-5(1968). (In German).

For the Gaussian approximation $\int_0^c f(x)e^{-x}\,dx = \Sigma_{i=1}^3 a_i f(t_i)$ the division points $t_i(c)$ and the corresponding weights $a_i(c)$ were evaluated. (auth)

10342 EVOLUTION IN CLOSE BINARY SYSTEMS. V. THERMAL PULSES IN THE WHITE DWARF COMPONENT OF A BINARY SYSTEM. Kippenhahn, R. (Univ., Goettingen, Ger.); Thomas, H.-C.; Weigert, A. Z. Astrophys., 69: 265-72(1968). (In German).

The further evolution was investigated for a white dwarf of $0.264M_\odot$ the formation of which in a binary system of originally $1M_\odot + 2M_\odot$ was calculated earlier (Kippenhahn, Kohl, and Weigert, 1967). The hydrogen shell source near the surface is secularly unstable, the thermal runaway is shown to result in two thermal pulses following each other in about 500 years. During these pulses, the model becomes a red giant; afterwards, the shell burning goes down and the model evolves quietly into the white-dwarf region. (auth)

10343 THREE COLOR PHOTOELECTRIC PHOTOMETRY OF THE CEPHEID VARIABLE AX CIR = BV 428. Mauder, Horst; Schoeffel, Eberhard (Univ., Erlangen-Nuernberg, Ger.). Z. Astrophys., 69: 258-64(1968). (In German).

Light curves in three colors were obtained and mean dimensions are estimated. The five-day cepheid shows a rather large amplitude defect f_s and seems to be redder than average cepheids of this period, $(B-V)^o_{mag}$ being $^m.63$. Its distance from the Sun is 630 pc, mean dimensions are 40.2 solar radii, 5.97 solar masses, the visual magnitude is $-3^m.41$. (auth)

10344 NEW BRIGHT PECULIAR AND METALLIC-LINE A STARS. Cowley, Anne P. (Univ. of Michigan, Ann Arbor). Publ. Astron. Soc. Pac., 80: 453-7(Aug. 1968).

A list of 24 metallic-line A stars, 28 peculiar stars, and ten other objects is presented. All are in the Catalogue of Bright Stars. Their spectra have not previously been recognized as abnormal. (auth)

10345 UBV OBSERVATIONS OF LONG-PERIOD VARIABLE STARS. IV. Landolt, Arlo U. (Louisiana State Univ., Baton Rouge. Kitt Peak National Observatory, Tucson, Ariz.). Publ. Astron. Soc. Pac., 80: 450-2(Aug. 1968).

Photoelectric observations of 17 long-period variable stars are presented on the UBV photometric system. (auth)

10346 A SPECTROSCOPIC SURVEY OF EARLY STARS FROM THE TONANTZINTLA LISTS, NEAR THE SOUTH GALACTIC POLE. Sanduleak, N. (Cerro Tololo Inter-American Observatory, La Serena, Chile); Philip, A. G. Davis. Publ. Astron. Soc. Pac., 80: 437-42(Aug. 1968).

A spectroscopic survey of a 230 square degree region surrounding the South Galactic Pole was made with the uv prism on the Curtis Schmidt telescope at Cerro Tololo and the 4° prism on the Tonantzintla Schmidt in Mexico. All the Tonantzintla stars in the area to photographic magnitude 13.7 were found and classified. The distribution of spectral types was one white dwarf, six B stars, seven A stars, and two F stars. Six additional interesting objects are discussed. (auth)

10347 PULSATING STARS. King, David S. (Univ. of New Mexico, Albuquerque); Cox, John P. Publ. Astron. Soc. Pac., 80: 365-405(Aug. 1968).

The current status of understanding of the causes and nature of stellar pulsation, as applied to classical Cepheids, RR Lyrae variables, and W Virginis variables, is reviewed. The historical development of these ideas is briefly surveyed, with emphasis on the search for the excitation mechanism(s). Tests of the idea that the instability is due to the ionization of one or more of the elements H, He, and He^+ in the stellar envelope, by means of both the linear and the more recent nonlinear calculations, are described and summarized. Some comparisons of theory and observation are made, particularly with respect to the period–luminosity relation, location of variables in the Hertzsprung–Russell diagram, fundamental versus first overtone mode, and phase relations between light and velocity curves. A number of special problems are discussed, including causes of the limitation of the pulsation amplitude to the observed values, relations between the light and velocity variations, and the interaction between pulsations and convection. A new physical interpretation, due to Castor, of the well-known "phase lag discrepancy" between the luminosity and radius variations is described. A number of previously unpublished results are presented, particularly with respect to recent nonlinear stellar pulsation calculations. (auth)

10348 LINE BLANKETING IN STARS. Krishna Swamy, K. S. (Goddard Space Flight Center, Greenbelt, Md.). Publ. Astron. Soc. Pac., 80: 406-9(Aug. 1968).

It is shown that scaled solar models are a better representation of stellar atmospheres than those models based on the grey-body temperature distribution law. (auth)

10349 THE OPEN CLUSTER NGC 6231. Feinstein, Alejandro; Ferrer, Osvaldo E. (Univ. Nacional de La Plata. Cerro Tololo Inter-American Observatory, La Serena, Chile). Publ. Astron. Soc. Pac., 80: 410-16(Aug. 1968).

Photometric data are given for 34 stars situated in the position of the very young open cluster NGC 6231. Two Of and two Wolf-Rayet stars belong to the cluster according to their magnitudes and colors. If the high-luminosity star HD 152236 (ζ Sco) is a cluster member, its absolute magnitude is $M_V = -7.4$. (auth)

10350 PHOTOELECTRIC OBSERVATIONS OF DS ANDROMEDAE AND RZ PYXIDIS. Breger, Michel (Univ. of California, Berkeley). Publ. Astron. Soc. Pac., 80: 417-23(Aug. 1968).

New photoelectric measurements for the two eclipsing binaries DS Andromedae and RZ Pyxidis are presented and discussed. (auth)

10351 THE 1967 PALOMAR SUPERNOVA SEARCH . Zwicky F. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Publ. Astron. Soc. Pac., 80: 462-5(Aug. 1968).

Ten supernovae were found with the Palomar Schmidt telescopes in 1967; they are listed and photographs are given. Galaxy types are estimated and magnitudes for the dates shown are given. (W.D.M.)

10352 THE SPECTRUM OF THE 1968 SUPERNOVA IN NGC 2713. Ford, W. Kent Jr.; Rubin, Vera C. (Carnegie Institution of Washington, D. C.). Publ. Astron. Soc. Pac., 80: 466-9(Aug. 1968).

Four spectrograms of SN-NGC 2713 were obtained shortly after discovery, spaced over six nights. The supernova is of Type I, with broad unidentified features in its spectrum. Intercomparison shows that a weak emission band near λ 4950 has increased in intensity during the time of observation. A spectrum of the galaxy has been obtained, giving V = 3610 km/sec corrected for galactic rotation. For a distance of 3.6×10^7 pc, the absolute magnitude of the supernova is $M_{pg} = -20$. There are significant differences between the spectrum of this supernova and that of the Type I supernova in NGC 3389 studied previously. (auth)

10353 A HIGH EXCITATION WOLF–RAYET STAR IN THE SMALL MAGELLANIC CLOUD. Sanduleak, N. (Case Western Reserve Univ., Cleveland. Cerro Tololo Inter-American Observatory, La Serena, Chile). Publ. Astron. Soc. Pac., 80: 470-3 (Aug. 1968).

The unusual spectrum of a Wolf–Rayet star in the Small Magellanic Cloud is described. Several other stars having similar spectral characteristics are also discussed. (auth)

10354 ULTRAVIOLET EXCESS OF THE SECONDARY COMPONENT OF S VELORUM. Sistero, R. F. (Observatorio Astronomico, Cordoba, Argentina). Publ. Astron. Soc. Pac., 80: 474-6(Aug. 1968).

UBV observations of S Velorum secured during the primary eclipse, when the secondary component is in front, taken at Cerro Tololo, are presented. The system has been classified spectroscopically as A5V + K5 III–IV. The observations give $(B-V) = 1^m.065 \pm 0.006$ (m.e.) and $(U-B) = 0^m.784 \pm 0.021$ (m.e.). (W.D.M.)

10355 ON THE EVOLUTION OF DETACHED ALGOL SYSTEMS. Hall, Douglas S. (Vanderbilt Univ., Nashville). Publ. Astron. Soc. Pac., 80: 477-80(Aug. 1968).

The values of the distribution of height above the galactic plane (Z) were calculated for the 18 detached and 39 semi-detached Algol binaries listed by Kopal (1959), and the 30 associations listed by Sharpless (1962). For each association, the distance used was that given by Sharpless. Results are shown in tabular form. (W.D.M.)

10356 UBV OBSERVATIONS OF V603 AQUILAE. (NOVA AQUILAE 1918). Landolt, Arlo U. (Louisiana State Univ., Baton Rouge. Kitt Peak National Observatory, Tucson, Ariz.). Publ. Astron. Soc. Pac., 80: 481-2(Aug. 1968).

Photoelectric UBV measurements were made of V603 Aquilae at the No. 3 16-inch reflector at Kitt Peak on May 21, 1968; results are shown. The data indicate the object to be fainter than has been reported in the past. The apparent magnitude together with a distance of 376 parsecs gave an absolute magnitude of $M_V = +3.1$. (W.D.M.)

10357 A SEARCH FOR RAPID LIGHT VARIATIONS IN WOLF–RAYET STARS. Wallerstein, George (Univ. of Washington, Seattle). Publ. Astron. Soc. Pac., 80: 482-3(Aug. 1968).

Due to the rapid optical variations of Sco XR-1 and Cyg XR-2, it has been suggested that Wolf–Rayet stars could be candidates for x-ray sources. During the nights of July 19, 20, and 21, 1968, six W–R stars of various spectral types were monitored with the 16-inch telescope at Rattlesnake Ridge. For no star were any variations noted that were greater than about 2%. Although the observations provide little encouragement for the suggestion that W–R stars may be x-ray sources, they do not prove the contrary. (W.D.M.)

10358 PHOTOELECTRIC SPECTROMETRY AND SPECTROSCOPIC OBSERVATIONS OF THE VARIABLE STAR VZ CANCRI. Morguleff, Nina; Terzan, Agop; Veron, Marie-Paule; Bloch, Marie (Institut d' Astrophysique, Lyon). Compt. Rend., Ser. A and B, 267: 657-60(Sept. 30, 1968). (In French).

Photoelectric spectrometry in eight colors and spectroscopic observations of VZ Cancri were made simultaneously with the 80- and 193-cm telescopes of the Haute Provence Observatory. A time variation of $\Delta T = 0.01634$ j (since 1950) was established for $\underline{m}_{max}$. The light curve, on the descending branch, has nonperiodic irregularities coming from intensity bursts emitted in the ultraviolet (flash). Radial velocity measurements were made during one period. (tr-auth)

10359 NUCLEOSYNTHESIS. Proceedings of a Conference held January 25–26, 1965, at the Institute for Space Studies, Goddard Space Flight Center, NASA, New York. Arnett, W. David; Hansen, Carl J.; Truran, J. W.; Cameron, A. G. W. (eds.). New York, Gordon and Breach, Science Publishers, Inc., 1968. 277p. $16.00. (CONF-650104).

Material in this work includes four papers dealing with ob-

servational data and eighteen papers concerned with the theory, both from the point of view of stellar evolution and from the viewpoint of theoretical and experimental physics. W.D.M.)

10360 CONTRIBUTION TO THE STUDY OF THE LOCAL GROUP. Froeschle, Christiane (Observatoire de Besancon, France). Compt. Rend., Ser. A and B, 267: 985-8(Oct. 28, 1968). (In French).

The spatial and kinematic properties of stars of spectral type O to B9, with known radial velocity, were studied in order to determine their relation to the local group and to estimate the approximate dimensions of this group. (tr-auth)

10361 GENERAL RELATIVISTIC INSTABILITY IN WHITE DWARFS. Wheeler, J. C.; Hansen, C. J.; Cox, J. P. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Astrophys. Lett., 2: 253-6(Dec. 20, 1968).

In order to examine the feasibility of a recent suggestion regarding possible precursors of type-I supernovae, the general relativistic instability towards dynamic collapse of zero temperature white dwarf models was investigated. The limiting central densities for stable models were found to lie in the range $1.8 \times 10^9 \lesssim \rho_c(\mathrm{gm/cm^3}) \lesssim 4.0 \times 10^{10}$ for various assumptions regarding μ_e. The lower limit is shown to be physically unrealistic, and it is concluded that, in white dwarfs having compositions with $12 \lesssim \bar{A} \lesssim 40$, relativistic effects are probably not the prime cause of instability. The limiting central densities of white dwarfs due to pycnonuclear burning and to secular instability are also discussed. (auth)

10362 SEARCH FOR CORRELATION BETWEEN ROTATIONAL VELOCITY AND SPACE VELOCITY IN EARLY-TYPE STARS. Havnes, O. (Univ. of Oslo, Blindern, Norway). Astrophys. Lett., 2: 239-41(Dec. 20, 1968).

For bright field stars of spectral class earlier than B4 a correlation between rotational velocity and space velocity relative to the Galaxy is found. It is suggested that these stars have attained their spin momentum and space velocity during a close encounter with another star in a small group of stars, leading to ejection. (auth)

10363 RADIO RECOMBINATION LINES: POPULATIONS OF HIGHLY-EXCITED STATES OF HYDROGEN. Hoang-Binh, D. (Observatoire de Meudon, France). Astrophys. Lett., 2: 231-4 (Dec. 20, 1968).

The effect of $\Delta n \geq 2$ collisional transitions on the differential departures from the equilibrium populations of the highly excited discrete energy levels is investigated. It is found that these quantities may be changed by an appreciable factor, compared with those obtained when only $\Delta n = 1$ transitions are taken into account. Using the data relative to the 94a hydrogen emission line observed by Gordon and Meeks (1968) in the center of the Orion Nebula the results predict an electron density in close agreement with that determined from continuum observations. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 10427.

10364 A SEARCH FOR PERIODIC RADIATION FROM CP 1919 AT 3.5 mm WAVELENGTH. Maran, S. P. (Kitt Peak National Observatory, Tucson, Ariz.); Penzias, A. A.; Schraml, J. Astrophys. Space Sci., 2: 334-5(Nov. 1968).

A search was made for periodic radiation at 3.5 mm from the pulsar CP1919. The best data were obtained on May 10, 1968, when the source was monitored for 4 hrs with the 36-foot paraboloid at Kitt Peak. The telescope was used in conjunction with a superheterodyne receiver having a Schottky-barrier diode mixer. No statistically significant event with a time duration in the range between one-half and twice the (37-msec) pulse width observed at lower frequencies appeared in the present data. An upper limit of $2.4 \times 10^{-26}\ W_m^{-2}\ (c/s)^{-1}$ was found for the mean intensity of pulses at 3.5 mm. (W.D.M.)

10365 ROTATING NEUTRON STARS AND THE NATURE OF PULSARS. Gold, Thomas (Cornell Univ., Ithaca, N. Y.). Nature (London), 221: 25-7(Jan. 4, 1969).

Recent observations of pulsars appear to support the rotating neutron star hypothesis. (auth) (UK)

10366 CLUSTERING OF PULSARS ALONG THE GALACTIC PLANE. Wielebinski, R.; Vaughan, A. E.; Large, M. I. (Univ. of Sydney). Nature (London), 221: 47(Jan. 4, 1969).

A conclusion reached on the basis of an earlier search at the Molonglo Radio Observatory, using the 408 MHz radiotelescope, was that pulsars are galactic objects associated with the disk or the spiral arms, but with a somewhat anomalous distribution. An avoidance zone along the inner regions of the galactic plane was suggested, based on the argument that dispersion in the thin layer of an ionised medium closely confined to the galactic plane results in the loss of the distant pulsars. The discovery of further pulsars that follow the same general pattern of galactic distribution is reported, and the characteristics of three new pulsars (MP 0940, 0959, 1747) are presented. The observed pulsar distribution indicated the presence of clusters closely associated with the spiral arm "tangential points," and there appeared to be a tendency for pulsars to be concentrated south of the galactic plane. The asymmetry of distribution may be due to the actual absence of pulsars, to an asymmetry in the dispersing medium, or to chance effects of pulsar amplitude fluctuations. An alternative explanation of clustering might be sought in an association of pulsars with supernovae. (UK)

10367 PULSAR AMPLITUDE VARIATIONS. Salpeter, E. E. (Univ. of Cambridge, Eng. Cornell Univ., Ithaca, N. Y.). Nature (London), 221: 31-3(Jan. 4, 1969).

Experiments on pulse-amplitude variations could distinguish intrinsic variations from scintillation effects and measure relevant scintillation parameters. (auth) (UK)

10368 STABILITY OF PULSAR PERIODS. Cole, T. W. (Univ. of Cambridge, Eng.). Nature (London), 221: 29-31(Jan. 4, 1969).

Several pulsars (CP 0808, 0834, 1133, 1919) appear to be slowing down, in a similar fashion to the Crab source, but at a much reduced rate. (auth) (UK)

10369 CHANGING PERIODICITIES IN THE PULSARS. Davies, J. G.; Hunt, G. C.; Smith, F. G. (Univ. of Manchester, Jodrell Bank, Eng.). Nature (London), 221: 27-9(Jan. 4, 1969).

A slowing down in the rates of four pulsars (CP 0834, 0950, 1133, and 1919) is reported. (auth) (UK)

10370 FREQUENCY STRUCTURE OF PULSAR INTENSITY VARIATIONS. Rickett, B. J. (Univ. of Manchester, Jodrell Bank, Eng.). Nature (London), 221: 158-9(Jan. 11, 1969).

A programme of observations at Jodrell Bank on ten pulsars showed that the long-term fading of pulse intensities at 408 MHz has a characteristic frequency width which varies with the dispersion measure of the source. The results can be explained by a scintillation mechanism due to irregularities of electron density distributed throughout the interstellar medium. Results are given for the total energy density received per pulse (pulse energy). The complex picture of the intensity fluctuations can be divided into long- and short-term regimes. The short-term component is characterized by fluctuations with a time scale independent of frequency, but varying from source to source from a fraction of a second (CP 0950) to a few minutes (CP 1919). The long-term fluctuations show a slow change of the ratio of pulse energies at different frequencies, and have time scales at 408 MHz ranging from a few minutes (HP 1506) to a few hours (CP 0950), the time scale and the width of the frequency structure increasing with increasing radio frequency for a given source. Results for the long-term fluctuations for CP 0328 are presented, using the digital autocorrelation spectrometer at Jodrell Bank. Characteristic bandwidths and dispersion measures are tabulated for ten pulsars, and a clear relationship is revealed between these parameters. It was indicated that sources with high dispersion measures have finer frequency structure than those with low measures, and it is concluded that those electrons which are responsible for the dispersion are also responsible for the frequency structure and fading. The dispersing electrons are distributed along the line of sight and not concentrated in a cloud near the source, and the long-term fading is caused by a propagation effect in the interstellar medium. The pulsar intensity variations can be described as a short-term fluctuation intrinsic to the source, modulated by a scintillation process due to propagation through the interstellar medium. The findings may have far-reaching consequences on the minimum-observable angular diameter of a radio source as a function of frequency, and on the study of intensity variations in very-small-diameter sources at high radio frequencies. (UK)

10371 PULSARS: WHITE DWARF ATMOSPHERIC PULSATIONS. Black, D. C. (Univ. of Minnesota, Minneapolis). Nature (London), 221: 157-8(Jan. 11, 1969).

The observed periods of pulsed radio sources suggest that atmospheric pulsations of white dwarfs is the responsible mechanism. In this communication a model is considered for a thin adiabatic atmosphere with a constant lapse rate; only the nondegenerate portion of the star is considered as participating in the oscillation. The oscillation equation for small deviations from equilibrium is obtained from mass, momentum, and energy conservation equa-

tions of a fluid. Rotation is neglected, only radial motion being considered; curvature terms may also be neglected for a thin atmosphere. The values for the period so obtained are consistent with observations to date. (UK)

10372 INTERSTELLAR SULFUR HYDRIDE: A SEARCH FOR THE 111-MEGAHERTZ LINES. Meeks, M. L.; Gordon, M. A.; Litvak, M. M. (Massachusetts Inst. of Tech., Lexington). Science, 163: 173-4(Jan. 10, 1969).

Similarities in the energy-level structure of the sulfur hydride radical and the hydroxyl radical suggest that sulfur hydride in the interstellar medium might be detectable because of a population inversion or anti-inversion similar to that of the hydroxyl radical. A search was made for the 111.54-MHz transition [F(total angular momentum quantum number) = 2 → 2] and for the 111.22-MHz (F = 1 → 1) in the galactic radio source W49, one of the brightest hydroxyl emission sources. No sulfur hydride emission lines with half-power widths of 130 hertz or greater were detected with the 1000-foot Arecibo antenna. The upper limits established with 100-hertz filters were 50 and 60 flux units (1 flux unit = 10^{26} watt meter^{-2} hertz^{-1}), respectively, for the two lines. (auth)

10373 SEARCH FOR SOFT X-RAYS FROM THE GALAXY. Grader, R. J.; Hill, R. W.; Seward, F. D. (California Univ., [Berkeley]). Sky Telesc., 37: 79-81(Feb. 1969).

A search for soft x rays from discrete sources is described. A Nike–Tomahawk was used and the instrumentation is shown. The effective zone of observation was between 0° and 30° altitude, where a number of galactic x-ray sources are located. (W.D.M.)

10374 CURVE OF GROWTH ANALYSIS OF THE ABSORPTION LINE SPECTRUM OF 3C 191. Grewing, Michael (Univ., Bonn); Schmidt-Kaler, Theodor. Z. Astrophys., 69: 247-57 (1968).

The equivalent widths of absorption lines of the quasi-stellar object 3C 191 according to Bahcall, Sargent, and Schmidt (1967) were used to determine an empirical curve of growth. Comparison to a theoretical curve yields the number of atoms integrated over the absorbing region for HI, NV, CII, CIV, SiII, SiIII, and SiIV. The SiII/SiIV and CII/CIV ratios are discussed, and it is concluded that the ionization is mainly due to collisional processes. The electron temperature is estimated to be $3.10^4 \leqq T_e \leqq 10^5$ °K. The integrated number of hydrogen atoms appears to be $\sim 5 \cdot 10^{20}$ cm^{-2} The conclusions which can be drawn from the observed ground-state fine-structure population of SiII are reviewed. Finally, five different models for the origin of the absorption line spectra of quasi-stellar objects are discussed. (auth)

10375 UBV OBSERVATIONS OF 3C 273. Burkhead, Martin S.; Parvey, Michael I. (Indiana Univ., Bloomington). Publ. Astron. Soc. Pac., 80: 483-6(Aug. 1968).

Photoelectric observations of 3C 273 were made on Feb. 2, 3, and 4, 1968, with the 24-inch reflector at Capilla Peak and later, in the spring, with the 16-inch reflector at the Goethe Link Observatory. The average nightly values of the magnitude and (B–V) and (U–B) values of 3C 273 are given. It appeared the magnitude was slowly increasing while the color indices remained relatively constant. (W.D.M.)

10376 INVESTIGATION OF SOME RADIO SOURCES DETECTED IN HIGH-FREQUENCY SURVEYS. Wills, D. (Cambridge Univ., Eng.). Astrophys. Lett., 2: 247-52(Dec. 20, 1968).

Some of the radio sources observed in high-frequency surveys are not listed in the 4C catalog. Examination of individual sources shows this to be due primarily to angular resolution of sources by the 4C interferometer and to confusion effects from nearby sources. Only a small fraction of the "missing" sources can have been excluded solely because of their unusual frequency spectra. (auth)

10377 REDSHIFT OF QUASARS. Barbieri, C. (Osservatorio Astronomico, Padua); Bonometto, S.; Saggion, A. Astrophys. Lett., 2: 225-7(Dec. 20, 1968).

The observed complex distribution of the redshift of quasars is interpreted as due to two simple-shaped distributions of cosmological and gravitational redshift. (auth)

10378 UPPER LIMIT TO CONTINUOUS EMISSION OF CP 1133 AT VARIOUS PULSE INTENSITY LEVELS. Lari, C.; Roffi, G. (Univ., Bologna). Astrophys. Lett., 2: 229-30(Dec. 20, 1968).

The upper limit to the continuous emission from CP 1133 is found to be 0.05 flux unit. (auth)

Solar Phenomena

Refer also to abstract 10465, 10525, 10530, 10533, and 10537.

10379 ANALYSIS OF FLUCTUATIONS IN THE INTERPLANETARY MAGNETIC FIELD OBTAINED BY IMP 2. Kawashima, Nobuki (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 74: 225-30(Jan. 1, 1969).

Data from the IMP 2 magnetic experiment obtained in interplanetary space were analyzed to study the character of the fluctuations in the magnetic field from the magnetohydrodynamic point of view. The fluctuation in interplanetary space is quite anisotropic relative to the steady magnetic field, with the fluctuations transverse to the magnetic line of force much larger than the longitudinal component of fluctuations. This anisotropy gradually decays as the amplitude of the fluctuation increases and tends to become rather isotropic. These fluctuations may be related to the thermal anisotropy of solar wind ions, with the conversion of the transverse fluctuations into the longitudinal ones occurring by means of a nonlinear effect when the amplitude of the fluctuation grows above a certain level. Frequency dependence of the mode of fluctuations was also investigated. (auth)

10380 INTERPLANETARY PLASMA ELECTRONS: A PRELIMINARY REPORT OF PIONEER 6 DATA. Formisano, V. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res., 74: 355-61(Jan. 1, 1969).

The MIT plasma experiment on Pioneer 6 has been occasionally able to detect the electron component of the solar wind. Preliminary results of an analysis of the interplanetary electrons are presented. Two periods of data are mainly discussed: the first in connection with the July 7, 1966, class 2B flare and the second, a more quiet period on Jan. 24, 1966. An attempt is made to give a qualitative answer to some of the more interesting problems concerning the interplanetary plasma electrons. (W.D.M.)

10381 EXPERIMENTAL EVIDENCE FOR A DETACHED LUNAR COMPRESSION WAVE. Siscoe, G. L.; Lyon, E. F.; Binsack, J. H.; Bridge, H. S. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res., 74: 59-69(Jan. 1, 1969).

The behavior of the solar wind flux and direction measured on Explorer 35 in the near lunar wake is presented. The flux near the leading edge of the wake tends to be greater than the free stream value and decreases below detectability near the wake axis. There is probably a small ($\lesssim 3°$) deflection of the wind away from the Moon near the leading edge and a deflection toward the wake axis in the region of reduced flux. These features correlate well with variations in the magnetic field. An interpretation of the observed structure is offered that utilizes the theory of two-dimensional steady simple waves in magnetohydrodynamics. A novel feature of the interpretation is the inference of a deflection of the solar wind from the region of the lunar limb to account for the structure near the leading edge of the wake. (auth)

10382 PARTICLE SHADOWING BY THE MOON. Van Allen, J. A. (Univ. of Iowa, Iowa City); Ness, N. F. J. Geophys. Res., 74: 71-93(Jan. 1, 1969).

During the period November 10–22, 1967, the Earth–Moon system was bathed in an isotropic, homogeneous beam of solar electrons and protons whose intensities were slowly varying functions of time. Detailed angular distribution and intensity observations of these particles and vector magnetometer observations made simultaneously by the lunar orbiting satellite Explorer 35 are combined to examine particle shadowing effects by the Moon. During the observing period, the Moon and Explorer 35 passed from interplanetary space through the magnetotail. Simultaneously observations were made by the Earth orbiting satellite Explorer 33, which was sunward of the Earth's shock front and at large radial distance from the Earth during most of the observing period. The angular distributions of the intensity of both electrons and protons were accurately isotropic within the magnetotail as well as in interplanetary space. Study of 33 cases of clear electron shadowing and two cases of less-clear shadowing suggests the following principal conclusions: (a) Magnetic lines of force from external sources thread through the Moon in a rectilinear manner as though it did not exist. The accuracy of this statement is measured by the maximum departure from rectilinear projection that is permitted by the electron shadowing observations. This is approximately 0.1 R_M(lunar radius) in 2 R_M or 3°. (b) Electron shadowing data provide no direct information on the region of access of interplanetary electrons into the magnetotail but do provide an upper limit on the trans-B diffusion velocity $v_\perp$ of electrons due to all causes. In the central portion of the magnetotail during magnetically quiet conditions and for radial distances $\lesssim 64$ R_E, $v_\perp \lesssim 100$ km sec^{-1} for 50 keV electrons. This upper limit requires, among other possibilities, that the transverse electric field $E_\perp$ ($= Bv_\perp/c$) $\leq 5 \times 10^{-4}$ volt meter^{-1}. Lunar shadowing of protons ($E_p \gtrsim 322$ keV) is also described and discussed but is of much less significance. (auth)

10383 ORIGIN OF SOLAR TYPE IV METER-WAVE STORMS. Fung, P. C. W. (Univ. of Tasmania, Hobart). Can. J. Phys., 47: 178-94(Jan. 15, 1969).

The features of cyclotron radiation from electrons gyrating in the possible source regions of both "moving" and "stationary" solar type-IV meter-wave storms are investigated. Assuming some models of spot magnetic field configuration and electron density distribution in the possible source regions, it is found that the majority of the important observed characteristics of type-IV meter-wave storms can be well accounted for by the cyclotron mechanism. If the magnetoactive plasma of the possible source region is specified by the quantity $A = f_p^2/f_H^2$ (where f_p = electron plasma frequency and f_H = electron gyrofrequency), both the solar type-I noise storm (Fung and Yip 1966a, b) and the second phase of type-IV meter-wave storm are considered to be generated by cyclotron radiation from electrons in the o-mode, but in ambient magnetoactive plasmas of slightly different values of A. From the present investigation, cyclotron radiation in the x-mode from electrons trapped in "frozen-in" magnetic fields in a source region where $A \approx 0.1$ can be applied to explain the main features of the type-IV meter-wave first-phase emission. (auth) (Canada)

10384 CORRELATION BETWEEN LOCAL SOLAR MAGNETIC FIELDS AND CENTRAL INTENSITIES IN SOME FRAUNHOFER LINES. von Klueber, H. (Cambridge Solar Research Station, Malta). Mon. Notic. Roy. Astron. Soc., 141: 469-77 (1968).

Many synchronized records of longitudinal magnetic field components and of central intensities in the Fraunhofer lines Hα, Hδ, K_3, Mg 5481 Å have been made at the Cambridge Observatories station in Malta. The records have been carefully calibrated and samples of these, together with Hα photographs of the surrounding areas, are given. (auth) (UK)

10385 NOTE ON THE QUIET-DAY SOLAR WIND. Miyajima, Shigeki (Nagoya Univ., Japan). Kakuyugo-Kenkyu, 22: No. 2, 67-90(Jan. 1969). (In Japanese).

The quiet-day solar wind has been fully discussed by Parker on the basis of the fluid model of plasma. He found that it is a supersonic flow of plasma in the solar gravitational field. The solar wind is again discussed using a two-fluid model of plasma. Two Bernoulli equations, which are coupled with the electric field and to each other, are complicated to analyze due to the many branches of the solutions. However, for the surface of the Sun, it is possible to apply the so-called quasi-linear approximation and to have a relatively simple solution. In this approximation, two parameters play important roles; one is γ related to the square of the initial velocity of ions and the other is β connected with the solar gravitational constant. When $\beta \simeq 3 - \gamma$ then the electric potential ϕ gradually decreases with increasing radius. When $\beta < 3 - \gamma$ or $\beta > 3 - \gamma$ then ϕ changes steeply or takes an extreme value at a certain radius respectively. Furthermore, there are the conditions $\gamma \geq 2\beta$ and $\gamma > 1$; the former is necessary in order for conservation of energy and the latter is identical to the Bohm criterion leading to the stable ion sheath. Since small changes of γ or β results in a large change of ϕ, so a set of the special combination of (γ,β) is required in order to find the solar wind at the orbit of the Earth. The results calculated by the quasi-linear approximation are compared with ones computed by a machine. Finally it is still unclear whether "The electron critical point" is present or not. (NSA of Japan)

10386 PHOTOSPHERIC BRIGHTNESS DIFFERENCES ASSOCIATED WITH THE SOLAR SUPERGRANULATION. Beckers, Jacques M. (Sacramento Peak Observatory, Sunspot, N. Mex.). Solar Phys., 5: 309-22(Nov. 1968).

The large-scale (>5000 km) intensity structure of the photosphere was examined. The power per frequency unit indicates a continuous increase toward smaller spatial frequency. No excess power exists at wavelengths near the size of the supergranulation (30,000 km) or at any other wavelength between 5000 and 100,000 km. However, direct measurement of the intensity distribution in 1652 supergranulation cells shows a very small increase of the intensity toward the cell boundary. The amount of this increase is larger near the solar limb. It is probably due to a weak continuum emission associated with the chromospheric network. Any temperature difference arising from the supergranulation convection is obscured by this emission and is probably less than 1°K. (auth)

10387 ON THE OBLITERATION OF STRONG FRAUNHOFER LINES BY ELECTRON SCATTERING IN THE SOLAR CORONA. Menzel, Donald H.; Pasachoff, Jay M. (Harvard Coll. Observatory, Cambridge, Mass. Smithsonian Astrophysical Observatory, Cambridge, Mass.). Publ. Astron. Soc. Pac., 80: 458-61 (Aug. 1968).

The invisibility of Fraunhofer lines in the inner corona at solar eclipses first indicated the very high temperatures present there. Scattering by fast electrons presumably washes out the lines. In this article it is emphasized that the evidence is still unclear whether the strongest photospheric absorption lines appear as wide depressions in the K corona, and data pertinent to the discussion are re-examined. (auth)

10388 NEW METHOD FOR THE ANALYSIS OF EQUIVALENT WIDTHS AND ITS APPLICATION TO SOLAR PHOTOSPHERIC OXYGEN. Altrock, Richard C. (Univ. of Colorado, Boulder). Solar Phys., 5: 260-80(Nov. 1968).

Six neutral atomic oxygen Fraunhofer multiplets were observed at nine disk positions at Sacramento Peak Observatory. The data were filtered and corrected for the instrumental profile, and equivalent widths were obtained. The equation of transfer for a plane-parallel atmosphere was solved to yield an expression for the equivalent width of a line or multiplet as a function of disk position; line source function, S_L, and relative population of the lower energy level of the transition. Comparison with the observations gives the abundance, average levels of formation of the lines, and S_L. The numerical results show that the weak lines are formed either in L.T.E. or pure scattering (i.e., $S_L \approx B_\nu(T_e) \approx J_c$), but for λ 7770 Å $S_L/B_\nu(T_e) \approx 0.6 \pm 0.1$ at $\tau_c = 0.1$. An analysis of the central intensities of λ 7770 Å yields essentially the same result. The results for λ 8446 Å are not reliable due to a possible blend with an iron line. The abundance of oxygen in the photosphere may be slightly less than that found by previous investigators. The results are consistent with the assumption that all levels of photospheric oxygen are populated as in L.T.E. with the exception of 3^5S, which is overpopulated by approximately 50% at $\tau_c = 0.1$. The overpopulation may be due to the metastability of this level. (auth)

10389 STUDY OF WEAK MOLECULAR AND ATOMIC LINES IN THE PHOTOSPHERIC SPECTRUM. Mallia, E. A. (Oxford Univ.). Solar Phys., 5: 281-302(Nov. 1968).

An attempt was made to detect the lines of ^{25}Mg H and ^{26}Mg H in the photospheric spectrum, using calculated isotope shifts. From comparisons with the ^{24}Mg H lines of the $^2\Sigma - ^2\Pi$ transition in the (0,0) band the ratios $^{25}Mg/^{24}Mg = 0.12 \pm 0.04$ and $^{26}Mg/^{24}Mg = 0.12 \pm 0.02$ were derived. These are essentially the same as the terrestrial ratios. The profile of one line of MgI confirms these values. The wavelengths of MgH and C_2 lines, when corrected for the gravitational redshift, indicate that macroturbulent (or streaming) velocities die out near $\log \tau_0 = -1.0$. From the equivalent widths of the MgH lines a rotational temperature of 5132 ± 200°K was obtained and compared to predictions from various model atmospheres. The band oscillator strength was found to 0.024 ± 0.002, in serious disagreement with the single laboratory determination. The profiles of MgH, C_2, CN and some weak atomic lines were used to derive the variation of the radial component of microturbulence with optical depth, on the assumption of streaming velocities of 2.5 to 3.0 km/sec. A slow increase with increasing height in the photosphere was found, over the range $-1.5 < \log \tau_0 < 0.2$. The center-limb variation of the equivalent widths of MgH and C_2 lines for a wholly inhomogeneous model was found to be the same as for a model which is homogeneous above $\log \tau_0 = -1.0$. With such a model as the latter, the center-limb variation of the profiles of the selected molecular and atomic lines is moderately-well reproduced by an anisotropic microturbulent velocity with a tangential component of 3 km/sec which seems to be constant with height over the range considered. (auth)

10390 FORBIDDEN LINES OF Fe II IN THE PHOTOSPHERIC SPECTRUM. Emerson, D.; Mallia, E. A. (Oxford Univ.). Solar Phys., 5: 303-8(Nov. 1968).

Divergence between determinations of the iron abundance from permitted Fe lines and forbidden Fe II lines discussed and a re-examination of the equivalent widths of two of the [Fe II] lines is proposed. (auth)

10391 HIGH-RESOLUTION PHOTOGRAPHY OF THE SOLAR CHROMOSPHERE. IV. SIZE, SHAPE, AND EVOLUTION OF THE DARK MOTTLES. Bray, R. J. (CSIRO, Sydney). Solar Phys., 5: 323-8(Nov. 1968).

Using photographs of the center of the solar disk with an effective resolution of 1 sec of arc or better, the size, shape, and evolution of dark mottles were studied. (auth)

10392 INTENSITY MEASUREMENTS OF CHROMOSPHERIC FINE STRUCTURES IN LYMAN-α. Sloan, William A. (Univ. of Hawaii, Honolulu). Solar Phys., 5: 329-37(Nov. 1968).

The intensity of the Sun was measured in the Lyman-α emission line with 2.5 arc-seconds of resolution. The experiment was flown in an Aerobee-150 rocket on April 28, 1966. It contained a Cassegrain telescope with a pinhole aperture placed at the focus followed by a gas-gain ionization chamber whose spectral response was

1050 to 1350 Å. An isophote map 1.5 by 3 arc-minutes in size made from a composite of 90 linear scans shows an enhanced region and adjacent to it a prominent dark lane 20 arc-seconds wide. The measured intensity ratio of these two regions is nine. Bright features between 6 and 20 arc-seconds in size showed typical peak intensities of 20% greater than the surrounding chromosphere. The smallest features observed were 2.5 arc-seconds in size. A direct measurement of the absolute intensity at 1216 Å gave a value of 5.9×10^4 erg cm^{-2} s^{-1} $sterad^{-1}$ in the quiet chromosphere. (auth)

10393 STRUCTURE OF A SUNSPOT. IV. A TWO-DIMENSIONAL RADIATIVE TRANSFER ANALYSIS OF CENTER-LIMB INTENSITY PROFILES. Wilson, P. R. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Solar Phys., 5: 338-53(Nov. 1968).

Typical intensity profiles across a sunspot at several heliocentric angles were selected from recent observations of the Wilson Effect. In addition, the profile of the mean intensity at the surface of the spot was inferred from these observed profiles. With these data, the transfer equation was solved for the two-dimensional source function distribution within the sunspot for several models of the opacity distribution. For an opacity model in which unit optical depth in the umbra occurs at least 700 km below unit optical depth in the mean photosphere, it is possible to reproduce qualitatively all the features of the observed profiles. Although no assumption is made about the extent of the umbra below the surface, these solutions clearly show that, at a depth of 700 km below unit optical depth in the photosphere, the diameter of the umbral region, which is 10,800 km at the surface, has increased to about 12,000 km. Thus the shape of the umbral region below the surface is part of an inverted cone of semi-vertical angle approximately 45°. The run of gas pressure and density in the umbra is computed for the model and compared with the corresponding photospheric values. (auth)

10394 ENERGY RELEASE BY MAGNETIC FIELD DISSIPATION IN THE SOLAR ATMOSPHERE. Kopecky, M.; Obridko, V. (Astronomical Inst., Ondrejov, Czechoslovakia). Solar Phys., 5: 354-8(Nov. 1968).

The energy release by Joule magnetic-field dissipation in the solar atmosphere is discussed. It is shown that the heating is unimportant in the case of granulation and intergranular space. In the case of spot features the additional temperatures ΔT, with the accounting of the radiation losses are no more than 30° for small new spots, ≈1° for the large umbrae, and 300° for bright points in large umbrae. This effect gives the possibility to suggest a hypothesis on the source of temperature inhomogeneity in the spot umbra and the nature of bright points. In the chromosphere the dissipation is negligible. (auth)

10395 ON THE TEMPERATURE DEPENDENCE OF THE RATIO OF O VIII Ly-α AND Ly-β RADIATION FROM THE SOLAR CORONA. Jacobs, A. (Space Research Lab., Utrecht). Solar Phys., 5: 359-60(Nov. 1968).

The incorporation of two-photon transitions between the levels 2s and 1s into the calculation of level populations of the hydrogenic O^{7+} ion reduces the coronal temperature, deduced from the Ly-α–Ly-β ratio, from $\sim 4 \times 10^6$ K to $\sim 1.5 \times 10^6$ K. (auth)

10396 REMARKABLE ERUPTIVE PROMINENCE ON THE SOLAR DISK ON JANUARY 29, 1968. Macris, C. J. (Astronomical Inst., Athens). Solar Phys., 5: 361-5(Nov. 1968).

Observations of a remarkable dynamic Hα phenomenon in projection on the solar disk are reported. An eruptive prominence in the shape of large loops was ejected to a great distance from the point of origin. (auth)

10397 POSSIBLE ACCELERATION MECHANISM FOR A SOLAR SURGE. Altschuler, Martin D.; Lilliequist, Carl G.; Nakagawa, Yoshinari (High Altitude Observatory, Boulder, Colo.). Solar Phys., 5: 366-76(Nov. 1968).

A nonlinear mechanism for a solar surge was examined in which plasma regions of high electrical conductivity and macroscopic dimension can be rapidly accelerated without diffusion of magnetic field. The mechanism is suggested by Rust's observations, which show that surges occur near sunspots in regions of reversed magnetic polarity. For the purpose of numerical calculation, the magnetic field near a polarity reversal in a sunspot is replaced by magnetic fields of current loops. The relaxation of the magnetic field generated by two antiparallel coaxial current loops in an incompressible plasma is traced by computer. The results suggest that plasma in the form of a vortex ring can be expelled at the Alfvén velocity from active solar regions. (auth)

10398 SPECTRUM OF THE SLOWLY VARYING COMPONENT OF SOLAR RADIO EMISSION AT WAVELENGTHS OF 3.3 mm TO 21 cm. Tlamicha, A. (National Radio Astronomy Observatory, Green Bank, W. Va.). Solar Phys., 5: 377-81(Nov. 1968).

The spectrum and diameter of the source of the S-component emission (McMath Plage No. 244) observed on March 4, 1968 was investigated at 3.3 mm, 4.3 mm, 8.5 mm, 2 cm, 9.1 cm, 21 cm, and 43 cm. (auth)

10399 SOLAR PARTICLE EVENTS OF MAY 23 AND MAY 28, 1967. Lindgren, S. T. (Univ. of California, Berkeley). Solar Phys., 5: 382-409(Nov. 1968).

McMath plage region 8818 passed over the visible solar disk on May 17–31, 1967. It was very active from its first appearance on the eastern limb, several times producing bright optical flares and hard x-ray emission, accompanied by intense Type-II, Type-IV, and centimeter radio bursts. Nevertheless, no solar particles could be detected near the Earth until the evening of May 23, when three bright flares were observed in close succession at 25°–28° E. During the following buildup of the solar particle flux over 36 hours, the galactic cosmic ray flux >1 GeV decreased gradually by about 5%. The flux of solar particles decreased in two steps on May 25, both accompanied by decreases in the equatorial geomagnetic field. These field depressions are attributed to storm plasma ejected from the parent flare of the May 23 particle event. The propagation of solar particles from May 23 on thus appears to be strongly affected by storm plasma from the parent flare of the May 23 event, without any indications of solar particles being trapped in that plasma. A later particle event early on May 28 was also associated with a bright flare in McMath region 8818, at 33° W. This event displayed a rapid buildup, with electrons arriving first, and an exponential decay. A smooth proton peak, 20 min wide, was detected on May 30 closely associated with an SSC attributed to plasma ejection from the parent flare of the May 28 event. Between the geomagnetic storms beginning on May 25 and May 30 an anomalous daily variation was observed in the cosmic-ray flux >1 GeV, the time of maximum falling 7 to 10 hours earlier than normal. Storm time increases in the flux of galactic cosmic rays were seen on May 26 when the equatorial geomagnetic field was depressed by more than 400 γ. Low-latitude auroras were also observed during that time. (auth)

10400 STAGES OF IONIZATION OF OXYGEN AND HELIUM IN THE SOLAR WIND. Kozlovsky, Ben-zion (California Inst. of Tech., Pasadena). Solar Phys., 5: 410-16(Nov. 1968).

An attempt is made to relate the relative abundance measurements of the solar wind at the Earth's orbit to conditions in the solar corona. The distribution of ionization stages of oxygen and helium was followed by integrating the coupled rate equations outward from the corona to the Earth's orbit. It is concluded that the material observed in the solar wind at the Earth's orbit must be a superposition of contributions from hotter and cooler regions of the corona. (auth)

10401 PHOTOSPHERIC NETWORK. Chapman, G. A. (Univ. of Arizona, Tucson. Kitt Peak National Observatory, Tucson, Ariz.); Sheeley, N. R. Jr. Solar Phys., 5: 442-61 (Dec. 1968).

Spectroheliograms, obtained in certain Fraunhofer lines with the 82-cm solar image at the Kitt Peak National Observatory, show a bright photospheric network having the following properties: (1) It resembles, but does not coincide with, the chromospheric network, the structure of the photospheric network being finer and more delicate than the relatively coarse structure of the chromospheric network. (2) It is exactly cospatial with the network of nonsunspot photospheric magnetic fields. (3) Its visibility in a given photospheric Fraunhofer line is primarily dependent on the states of ionization and excitation from which the line is formed and secondarily dependent on the Zeeman sensitivity of the line—being most visible in low-excitation lines of neutral atoms and least visible in high-excitation lines of singly ionized atoms. It is concluded that these magnetic regions of the solar atmosphere are a few hundred degrees hotter than their surroundings, and that they are visible in white light near the limb as photospheric faculae. (auth)

10402 IDENTIFICATION OF A SOLAR X-RAY SOURCE USING D-LAYER IONIZATION BEHAVIOR DURING AN ECLIPSE. Meisel, David D. (Leander McCormick Observatory, Charlottesville, Va.). Solar Phys., 5: 575-87(Dec. 1968).

Semi-quantitative reports of shortwave radio reception during the November 12, 1966, total solar eclipse were used to determine the characteristics of a major source of D-layer ionization. An effective electron depletion coefficient of 1.2×10^{-2} sec^{-1} was found empirically and used to reduce the data. Analysis of the radio absorption shows the source was located near heliographic coordinates, B = +7°, L = 340° and was probably less than 0'.5 of arc in diameter. At the time of the eclipse, the source accounted

for 40% of the radio absorption on a single, vertical pass through the D layer. Preoccultation behavior of the signal strength was interpreted by assuming a portion of the source x-ray flux was reflected at grazing incidence from the limb of Moon. For point sources, such reflections have specific chromatic characteristics which were used to derive a crude source spectrum in the 3- to 140-A range. X-ray absorption edges of N, O, Na, Be, and possible Mg, Ar, Ne, Ca, and K arising from the terrestrial atmosphere were identified. A source temperature approximately twice that of the rest of the corona is indicated. (auth)

10403 SPECTROSCOPIC INVESTIGATION OF A BIREFRINGENT LYOT FILTER FOR Hα. Krafft, Marina (Fraunhofer Institut, Freiburg i. B.). Solar Phys., 5: 462-70(Dec. 1968).

The instrumental profile of a Lyot-filter with 0.5 Å pass-band for Hα was determined from photographic spectra obtained with a large grating spectrograph and a continuous light source. After fine adjustment of the filter, the transmission profile in parallel light agrees closely with the theoretical profile as given by crystal optics. The peak transmission was found to be 12% of the incident unpolarized radiation. Convolving the measured instrumental profile with the average solar spectral distribution near Hα, it can be shown that the parasitic light (transmission outside the main pass-band) contributes 10% to the total light flux with the filter centered on the line. At wavelength shifts of 0.5 and 0.8 Å, the parasitic light contribution is 25% and 40%, respectively. The deformation of the line profile of various solar phenomena (faculae, filaments, flares) by the instrumental profile is discussed quantitatively. (auth)

10404 INDICATION OF THE CORPUSCULAR STREAMS BASED UPON THE SUN'S INTEGRAL RADIOSERVICE. Tsimakhovich, N. P. (Radiophysical Observatory, Riga). Latv. PSR Zinat. Akad. Vestis, No. 5, 74-7(1968). (In Russian).

Four-frequency characteristics of radiobursts have been found. A table is given of 43 type-IV radiobursts identified by means of their four-frequency characteristics. (auth)

10405 THE BRIGHT STREAKS IN THE Hα DISK CHROMOSPHERE. Bhavilai, Rawi (Chulalongkorn Univ., Thailand. Applied Scientific Research Corp., Thailand). Solar Phys., 5: 471-88(Dec. 1968).

Evidence is presented demonstrating the existence of a type of chromospheric structure in the form of bright streaks. These are extensions across the solar disk of elongated bright mottles which originate in the central regions of clusters of mottles. They are best observed on good filtergrams at Hα ± 0.5 Å through comparison with filtergrams at other positions on the line profile. Their length can be as much as 200 sec of arc. The bright streaks appear to be predominantly horizontal loop structures, while the well-known spicules are mainly vertical structures. A bright streak may be well defined or rather diffuse along its length, and many of them are accompanied by darker boundaries or envelopes. It is usual to find a loop of bright streak bridging the central areas of two mottle clusters. It seems that the observed pattern in the space between the chromospheric network at Hα ± 0.5 Å results partly from the interactions of the bright streaks of different stages of evolution traversing the area in different directions. (auth)

10406 HIGH-RESOLUTION PHOTOGRAPHY OF THE SOLAR CHROMOSPHERE. V. THE FIBRILS AROUND ISOLATED SUNSPOTS. Loughhead, R. E. (Commonwealth Scientific and Industrial Research Organization, Sydney). Solar Phys., 5: 489-97(Dec. 1968).

High-quality Hα photographs of the solar chromosphere reveal the presence around isolated sunspots of a pattern of elongated dark elements (fibrils) bearing a strong resemblance to a greatly enlarged version of the white-light penumbra. Individual fibrils have a representative length of some 25'' of arc (18,000 km) and a typical separation of 2 to 3''. Comparison of pairs of photographs separated by intervals ranging from 0.5 min to 42 min shows that the fibrils undergo continual changes in brightness, size, and shape; their average lifetime is about 17 min. The question is raised whether the fibril structure around a spot is related in any way to be observed inflow of material from the surrounding chromosphere (Evershed effect). (auth)

10407 A COMPARISON OF 3.3-mm BURSTS AND Hα EMISSION DURING FLARES. Shimabukuro, F. I. (Aerospace Corp., El Segundo, Calif.). Contract F04695-67-C-0158. Solar Phys., 5: 498-506(Dec. 1968).

Radio bursts observed at a wavelength of 3.3 mm are always associated with flares. The enhancement in the millimeter emission is strongly correlated with some optical event that is associated with the flare. Emissions in the bursts observed thus far, with the possible exception of those associated with proton flares, have not been large increases over quiescent readings and can be explained by a thermal mechanism. (auth)

10408 RELATIVISTIC ELECTRONS FROM SOLAR FLARES. Cline, T. L.; McDonald, F. B. (Goddard Space Flight Center, Greenbelt, Md.). Solar Phys., 5: 507-30(Dec. 1968).

Observations of interplanetary relativistic electrons from several solar-flare events monitored through 1964 to mid-1967 are presented. These are the first direct spectral measurements and time histories, made outside the magnetosphere, of solar-flare electrons having relativistic velocities. The 3- to 12-MeV electrons detected have kinetic energies about two orders of magnitude higher than those solar electrons previously studied in space, and measurements of both the time histories and energy spectra for a number of events in the present solar cycle were carried out. These measurements of interplanetary electrons are also directly compared with solar x-ray data and with measurements of related interplanetary solar protons. The time histories of at least four electron events show fits to the typical diffusion picture. A demonstrated similarity between the electron and the medium-energy proton fits for the event of July 7, in particular, indicates that at these electron energies, but over several orders of magnitude of rigidity, whatever diffusion does take place is very nearly on a velocity, rather than a rigidity or an energy, basis. Diffusion-fit time histories varied as a function of T_0 also indicate that the electrons in certain flare events originate at times near the x-ray and microwave burst, establishing their likely identity as the same electrons which cause the impulsive radiations. Also, the energy spectra and total numbers of the interplanetary electrons, compared with those of the flare-site electrons calculated from x-ray and microwave measurements, indicate that probably a small fraction of flare electrons escape into interplanetary space. (auth)

10409 DETERMINATION OF THE CORONAL MAGNETIC FIELD AND THE RADIO-EMITTING ELECTRON ENERGY FROM A TYPE IV SOLAR RADIO BURST. Ramaty, Reuven (Goddard Space Flight Center, Greenbelt, Md.); Lingenfelter, Richard E. Solar Phys., 5: 531-45(Dec. 1968).

The intensity and frequency spectrum of gyro-synchrotron emission from energetic solar electrons radiating in coronal magnetic fields were calculated. These calculations, based on a recent study of the generation of gyro-synchrotron emission in a magnetoactive plasma, were applied to a type-IV radio burst originating at a high altitude in the solar corona. It is shown that the observed frequency spectrum of the burst, which exhibits very sharp low- and high-frequency cutoffs, can be best understood in terms of gyro-synchrotron emission in an ionized medium and that from the observed frequency spectrum and the ambient coronal density it is possible to deduce both the magnetic field at the site of the emission and the range of electron energies responsible for the burst. (auth)

10410 FLUX AT 44 TO 60 A DURING THE ASCENDING PERIOD OF THE SOLAR CYCLE No. 20 (1964–67). Landini, M.; Monsignori Fossi, B. C.; Poletto, G.; Tagliaferri, G. L. (Osservatorio Astrofisico di Arcetri, Florence). Solar Phys., 5: 546-50(Dec. 1968).

An attempt was made to separate the "true" 44 to 60-Å flux from the "nominal" one measured by the Solrad 8 satellite during 1966. The 44 to 60-Å flux recorded at Arcetri through the telemetry of the Solrad 6, 7, and 8 satellites was also examined in order to study its time variations in comparison with other indices of solar activity. (auth)

10411 CORONAL X-RAY EMISSION AT 16 TO 40 A DURING THE NOVEMBER 12, 1966 ECLIPSE. Argo, H. V.; Bergey, J. A.; Evans, W. D.; Singer, S. (Los Alamos Scientific Lab., N. Mex.). Solar Phys., 5: 551-63(Dec. 1968).

The solar eclipse of November 12, 1966, was used to study the coronal emission near the limbs in selected emission lines between 16 and 40Å. Eight fixed-wavelength, curved-crystal spectrometers were carried in each of 3 rocket launches to an altitude of 290 km and monitored the flux in each of eight narrow-wavelength intervals encompassing the principal emission lines from the hydrogen-like and helium-like ions of C, N, and O. At totality the emissions dropped to background levels of 1% or less of the full Sun values, showing that on the solar limbs on that day there was very little emission above 17,000 km in these lines. (auth)

10412 LARGE-SCALE PATTERN IN THE SOLAR MAGNETIC FIELD. Wilcox, John M. (Univ. of California, Berkeley); Howard, Robert. Solar Phys., 5: 564-74(Dec. 1968).

A clearly evident large-scale pattern in the interplanetary magnetic field during 1964 was used to search for a similar

large-scale pattern in the solar magnetic field. It was found that such a pattern did exist in the photospheric field observations on both sides of the equator over a range of at least 40°N to 35°S. The pattern was basically similar at all these latitudes, and differs from that to be expected from solar differential rotation in three important respects. It was found that the solar magnetic pattern changed at all latitudes investigated within an interval of a few solar rotations. (auth)

10413 ABUNDANCE OF BERYLLIUM IN THE SOLAR ATMOSPHERE. Hauge, Oe.; Engvold, O. (Univ. of Oslo, Blindern, Norway). Astrophys. Lett., 2: 235-8(Dec. 20, 1968).

A beryllium abundance of log N(Be) = 0.96 was obtained for the solar atmosphere. This value is more than a factor of ten less than usually assumed. The implications of the increased Li/Be ratio are discussed. (auth)

10414 SPECTRUM OF THE INJECTION OF SOLAR-FLARE PROTONS. Miroshnichenko, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 448-9(1968).

Translated from Geomagn. Aeron., 8: 563-4(1968).

A table is presented which gives the injection spectra obtained by the authors and other researchers for several flares observed by the ground-based network of neutron-monitor stations and by Explorer 12 and 14. The flares were selected on the basis of the availability of appropriate experimental data. (W.D.M.)

Galaxies

Refer also to abstract 10469.

10415 EVOLUTION OF GALAXIES. Reddish, V. C. Quart. J. Roy. Astron. Soc., 9: 409-24(Dec. 1968).

This paper is concerned with discovering how the properties of galaxies change with time, and in what ways they may be dependent on initial conditions. The subject is considered within the framework of integrated properties such as masses, gas masses, luminosities, spectra, motions, and structural properties. (UK)

10416 THE DISTRIBUTION OF WOLF–RAYET STARS IN THE GALAXY. Smith, Lindsey F. (Univ. of California, Los Angeles). Mon. Notic. Roy. Astron. Soc., 141: 317-27(1968).

The distances of galactic Wolf–Rayet stars are derived and their distribution on the galactic plane is shown. It is found that the various subclasses show differing degrees of concentration towards the galactic centre. All WC_9 stars appear to be located within 7 kpc of the galactic centre; WN 6 and WC 7 stars show a concentration to the area within 9 kpc of the galactic centre; other subclasses are concentrated to the area outside 9 kpc of the galactic centre. Since the three subclasses that show concentration to the area within 9 kpc of the galactic centre are missing from, or rare in, the Large Magellanic Cloud it is concluded that the stellar population in the Large Magellanic Cloud is very similar to that in the solar neighbourhood but quite unlike that in the inner regions of the Galaxy. Previous rate of star formation is suggested to be the controlling factor. The overall pattern of the Wolf–Rayet distribution suggests spiral arms with inclinations of 3 to 5°, in qualitative agreement with the theory of a spiral pattern arising from density waves suggested by Lin & Shu (1964, 1966, 1967). The Wolf–Rayet stars are strongly concentrated to the inner edges of the H I and OB spiral features in Cygnus and Carina. Consistency with the density wave model is possible if star formation occurs mainly on the inner edges of spiral arms and if the Wolf–Rayet stars are exceedingly young objects. (auth) (UK)

10417 PECULIAR OPTICAL STRUCTURE OF GALAXIES IN A CENTRAL FIELD OF THE COMA CLUSTER. Rood, Herbert J. (Wesleyan Univ., Middletown, Conn.). Publ. Astron. Soc. Pac., 80: 424-36(Aug. 1968).

Several galaxies in a central field of the Coma cluster show structural pecularities on well-exposed 200-inch plates. Six categories are discussed: (1) supergiant size, (2) jet appendage, (3) fan appendage, (4) multiple central bulge, (5) contact double, and (6) other. An analysis of all available data suggests that an appreciable fraction are cluster members. Properties of Coma and non-Coma optically similar peculiars are compared and possible interpretations are discussed. (auth)

10418 SOLAR MOTION FROM DISTANT OBJECTS. Crampton, David (Dominion Astrophysical Observatory, Victoria, B. C.). Publ. Astron. Soc. Pac., 80: 443-9(Aug. 1968).

It does not appear advisable to use only the local solar motion in studies of the kinematics of distant objects. It is recommended that simultaneous solutions of the solar motion and galactic rotation parameters be carried out in further studies of galactic kinematics. (auth)

10419 POSSIBLE INTERPRETATION OF MIDDLE-LATITUDE TYPES OF E. Mal'tseva, O. A.; Chernysheva, S. P. (Rostov-on-the-Don State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 468-70(1968).

Translated from Geomagn. Aeron., 8: 585-6(1968).

Rocket data indicate that the true heights of E_s appearance are quite definite, but the existing classification of E_s by types does not reflect the type of E_s on ionograms with a definite form of electron concentration profile. E_s is compared, classified as types l, c, and h on ionograms, with data on electron concentration profiles. Models of middle-latitude types of E_s were selected, and the ionograms were computed for them by the lamination method of Titheridge at an interval $\Delta f = 0.1$ MHz. (W.D.M.)

10420 METASTABLE HELIUM IN INTERSTELLAR AND INTERGALACTIC SPACE. Rees, M. J.; Sciama, D. W.; Stobbs, S. H. (Cambridge Univ., Eng.). Astrophys. Lett., 2: 243-6 (Dec. 20, 1968).

The possibility of detecting helium in the metastable 2^3S state in the interstellar and intergalactic medium is discussed. The results of a search for absorption lines could yield significant information on the cosmic-ray heating rate in the interstellar medium. Intergalactic effects might also be observable. (auth)

Cosmology

10421 RELATION BETWEEN CLASSICAL AND RELATIVISTIC SHOCK WAVE THEORIES BY MEANS OF SHOCK TUBE TESTS. v. Krzywoblocki, M. Z. (Michigan State Univ., East Lansing). Astrophys. Space Sci., 2: 370-4(Nov. 1968).

A laboratory simulation is proposed of cosmic shock waves by means of the mathematical correlations between the shock equations in the classical and the relativistic fluid dynamics, respectively. Only the normal shock is treated. (auth)

10422 REVIEW OF RECENT DEVELOPMENTS IN COSMOLOGY. Hoyle, F. Proc. Roy. Soc. (London), Ser. A, 308: 1-17 (Dec. 17, 1968).

A review, with 11 references, is presented. Among matters considered are the "big band" model versus the "stationary-state" model, quasars and radiogalaxies, red-shift magnitudes, etc. It is stated that the "steady-state" theory has had to face six different crises over the past 20 years, five of which have been wholly or largely surmounted; the sixth, concerned with the microwave background, remains to be resolved. (UK)

10423 COSMOLOGICAL MODELS WITH AN ANTIPOLE. Rowan-Robinson, M. (Queen Mary Coll., London). Mon. Notic. Roy. Astron. Soc., 141: 445-58(1968).

The properties of Lemaître models are summarized and the luminosity–volume test is used to determine which of these models are consistent with the distributions in space of quasars and radiogalaxies, respectively. Ranges of models can be found consistent with either, but not both, of these classes of radio-source, including models which could account for the anomalous absorption redshift of 1.95 in quasars. The integrated extra-galactic radio background provides an important additional constraint to the problem. No model is found to agree with the observed radio source counts, without the introduction of evolutionary effects. (auth) (UK)

10424 REDUNDANT WORLD MODELS. Crilly, A. J. (Univ. of Liverpool). Mon. Notic. Roy. Astron. Soc., 141: 435-43(1968).

When the maximum red-shift criterion is introduced into the field equations for the homogeneous and isotropic, "pressure-free" world models, new analysis for the A_2 and M_2 models shows that considerable elimination is possible. The analysis used with the large red-shift of PKS 0237-23 ($z = 2.22$) ensures that for these models q_0, the acceleration parameter, is low and about the same order as obtained from an accumulation of apparent magnitude–red-shift data. Complete elimination of the A_2 and M_2 models is possible, given larger red-shift measurements. (auth) (UK)

10425 QUASISTELLAR OBJECTS AND SEYFERT GALAXIES. Colgate, Stirling A. (New Mexico Inst. of Mining and Tech., Socorro). Phys. Today, 22: 27-35(Jan. 1969).

The possible relationship between quasars and Seyfert galaxies is considered. It is conjectured that evolution of dense stellar clusters, so crowded with stars that collisions occur, yielding more massive stars and supernovae, could be the common origin of both. The properties of both classes of objects are reviewed

and evidence for a similar origin is presented. Other topics considered include theory and energy, sudden release of energy, supernova theory, star-cluster evolution, stellar disruptive collisions, coalescence, coalescence of whole cluster, stellar growth and fluctuations, limiting massive star, gas cloud, luminosity and line emission, and infrared emission. (W.D.M.)

10426 RELATIVITY AND COSMOLOGY. Robertson, H. P.; Noonan, Thomas W. Saunders Physics Books. Philadelphia, W. B. Saunders Company, 1968. 486p.

The fundamentals of special relativity, general relativity, and cosmology are presented with particular emphasis and development of the electromagnetic stress–energy tensor in special relativity, the Poynting–Robertson effect, the experimental basis for special relativity, discussion of special-relativistic gravitational theories, the geometric foundation for Reimannian geometry, derivation of the cosmological metric from group theory, discussion of cosmological models, rotation of coordinate systems in general relativity, electromagnetism in media in general relativity, rotationally symmetric general-relativistic solutions, Gödel's cosmological model, and geodesic precession. (W.D.M.)

10427 OSCILLATING PERFECT-FLUID SPHERE WITH UNIFORM DENSITY. Tomita, Kenji; Nariai, Hidekazu (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 40: 1184-6(1968).

In a previous note (1968), the authors derived the necessary conditions for a perfect-fluid-uniform density sphere to bounce or oscillate outside its Schwarzschild surface. In this note, a simple oscillating model including four independent parameters is shown. (W.D.M.)

Planetary Phenomena

10428 EXPLORER 35 MEASUREMENTS OF LOW-ENERGY PLASMA IN LUNAR ORBIT. Serbu, G. P. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 74: 372-6 (Jan. 1, 1969).

The purpose of this letter is to present some preliminary observations of low-energy plasma E < 500 eV, taken during lunar orbits of Explorer 35. The plasma measurements were made by means of a planar multigrid sensor programmed as a retarding potential analyzer. (W.D.M.)

10429 ANALYSIS OF THE LYMAN-ALPHA OBSERVATIONS OF VENUS MADE FROM MARINER 5. Wallace, L. (Kitt Peak National Observatory, Tucson, Ariz.). J. Geophys. Res., 74: 115-31(Jan. 1, 1969).

A detailed analysis is presented of the Lyman-α observations of Venus made from Mariner 5. In the analysis, it is assumed that the observed emission is the result of resonance scattering of the solar Lyman-α flux by hydrogen or hydrogen and deuterium atoms in the atmosphere. The variation of the atomic densities with altitude is taken from the exospheric models of Chamberlain and McAfee. Radiative transfer effects are included but are not of crucial importance to the analysis. It is found that an exospheric model consisting only of atomic hydrogen fails to give an adequate representation of the data. Instead, two constituents with mass ratios in the range 2 to 3 are required. A reasonable fit to the data is made with the hydrogen–deuterium model after large asymmetries are introduced in the densities at the base of the exosphere. This model indicates that in the subsolar region the exospheric temperature is about 640°K and the hydrogen and deuterium densities are about 6×10^3 and 10^5 at 6500 km from the center of the planet. The degree of asymmetry is uncertain, but a reduction in the deuterium density by a factor of 10 and in the hydrogen density by a factor of 2 in the antisolar region at 6500 km is suggested by the night-side intensities. (auth)

10430 OBSERVATIONS OF JUPITER'S POLARIZED RADIATION AT 6.6 cm WAVELENGTH BY MEANS OF THE GREAT PULKOV RADIO TELESCOPE. Gol'nev, V. Ya.; Pariiskii, Yu. N.; Soboleva, N. S. (Main Astronomical Observatory, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1455-60(1968). (In Russian).

A considerable asymmetry of Jupiter's radiation belts in a polarized light has been discovered. The assumption is made on the deformation of radiation belts by a solar wind. (auth)

Atomic and Molecular Physics

Refer also to abstracts 9804, 10328, 10336–10338, 10363, 10490, 10531, 10634, 10675, 10723, 10906, 10955, 10970, 10994, and 11008.

10431 (NP-17736) SURFACE AND VACUUM PHYSICS INDEX. Bibliography; Author Index; Subject Index. Volume 3, No. 10 (1446–1596). Hilsenbeck, D. (ed.) (Zentralinstitut fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 59p. Dep.

150 articles dealing with surface and vacuum physics are listed. Subject and author indexes are included. (M.O.W.)

10432 (ORNL-4316, pp 161-229) RADIATION PHYSICS. Birkhoff, R. D.; Ritchie, R. H. (Oak Ridge National Lab., Tenn.).

ALUMINUM OXIDES—optical properties of
ATOMS—electron scattering on exchange and nonadiabatic polarization effects in, (T)
COLLISION PROCESSES—electron scattering on atomic and molecular systems, exchange and nonadiabatic polarization effects in, (T)
COPPER—photoelectric measurements for, (E)
CROSS SECTIONS—scattering for electron collisions with polar molecules, (E)
ELECTRONS—buildup calculations for 2 GeV protons on soft tissue slabs, (T)
—scattering on atomic and molecular systems, exchange and nonadiabatic polarization effects in, (T)
—scattering on polar molecules, cross sections for, (E)
—reactions with halogenated aliphatic and aromatic hydrocarbons, dissociative attachment in
—diffusion coefficients for thermal, in gases, (T)
—reactions with matter, slowing down spectra for, (T)
HYDROCARBONS—electron reactions with, mean attachment cross sections for, (E)
MOLECULES—electron scattering on exchange and nonadiabatic polarization effects in, (T)
—electron scattering on polar, cross sections for, (E)
NEUTRONS—dosimetry of 400 MeV to 2 GeV, using soft tissue slabs
NICKEL—photoelectric measurements for, (E)
PALLADIUM—photoelectric measurements for, (E)
PLASMA—radiations from, quantum theory of resonance
PROTONS—reactions with soft tissue slabs at 2 GeV, delta-ray buildup in, (T)
TELLURIUM—optical properties of vacuum-evaporated films of polycrystalline, (E)
TISSUES—proton reactions at 2 GeV, delta-ray buildup in, (T)
—use of soft slabs for neutron dosimetry at 400 MeV to 2 GeV (M.O.W.)

10433 (ORNL-AMPIC-11) BIBLIOGRAPHY OF ATOMIC AND MOLECULAR PROCESSES FOR JANUARY–JUNE 1968. (Oak Ridge National Lab., Tenn.). Jan. 1969. 288p. Dep. CFSTI.

This annotated bibliography contains references of interest to atomic and molecular processes research. Bibliographical sources consist of eighty-six scientific journals and five abstract journals. The references are classified into fourteen major categories with appropriate subcategories and are entered alphabetically in each category with the reactants or the atomic and molecular system of interest. (auth)

10434 (ORO-3349-4) RADIATION INDUCED LUMINESCENT PROCESSES IN GASES. Progress Report. Llewellyn, J. A.; Glick, R. E.; Keirs, Russell J. (Florida State Univ., Tallahassee). Nov. 29, 1968. Contract AT(40-1)-3349. 59p. Dep. CFSTI.

Luminescence induced by 5-MeV protons in N_2 and N_2-O_2 mixtures was examined and the energy transfer mechanisms governing the intensities for the principal emissions were deduced. Quenching cross sections for two $N_2C^3\pi_u$ levels interacting with O_2 are provided by the kinetic analyses. Two experimental arrays, using a low-energy (keV) electron impact luminescence source, have been set in operation. These are capable of determining the spatial distribution of luminescence about the exciting electron beam and can operate from the near infrared to the vacuum uv. At low pressures an attempt has been made, using these sources, to establish for N_2 a list of excited species and their relative production rates as a basis for understanding the higher-pressure observations. The states observed are those that might be anticipated on the basis of a "white light" model for excitation and provide qualitative confirmation of some theoretical Franck–Condon calculations for several of the observed transitions. At slightly higher pressures the onset of secondary processes has been observed by the rapid development of the optically forbidden $N_2C^3\pi_u$ excited state, presumably excited by the low-energy secondary electrons derived from ionization processes. This adds strength to the hypothesis that the intensity of the second positive bands in N_2 can be used as an index of the secondary electron flux. Experiments with $Ne-N_2$ mixtures have been carried out in the low-energy source, paralleling earlier investigations in this system using 3-MeV electrons and

5-MeV protons. The $N_2^+ B^2\Sigma_u^+$ states are rotationally excited during the energy transfer from Ne^* to N_2 and detailed examination is in progress. (auth)

10435 MULTIPLE SOLUTIONS OF HARTREE–FOCK EQUATIONS. Mjolsness, R. C.; Ruppel, H. M. (Los Alamos Scientific Lab., N. Mex.). J. Comput. Phys., 3: 259-72(Oct. 1968).

In the calculation of electron–atom cross sections it is often quite useful to obtain wave functions for the scattered particles that are orthogonal to the wave functions of the electrons bound in the atom. This constraint, although it may neglect certain couplings, provides a considerable simplification in obtaining certain transition matrix elements. A straightforward technique for enforcing this orthogonality condition is to include Lagrange multipliers in the differential equation. It has been found that depending on the values of the Lagrange multipliers there may be zero, one, or two solutions. However, the solution that yields orthogonality is unique. Noniterative schemes for solutions are discussed and applied to electron–hydrogen atom scattering. (auth)

10436 THERMALIZATION TIMES OF POSITRONS IN POLYATOMIC GASES. Paul, D. A. L.; Leung, C. Y. (Univ. of Toronto). Can. J. Phys., 46: 2779-88(Dec. 15, 1968).

The time taken for positrons from a radioactive source to reach a velocity distribution in the near-thermal range has been measured for mixtures of nitrogen gas with argon, and of methane with argon. An analysis of the shoulder breadths for the free positron components leads to slowing down times of 16 ns for nitrogen and 0.25 ns for methane at densities of 1 amagat. The long slowing time for nitrogen must occur during the last eV or so of slowing and the dominant mode of energy loss is attributable to rotational excitation of the molecules. For methane the slowing to the threshold for vibrational excitation must be extremely rapid, but there is no clearly established mechanism which could account for the remaining energy loss taking place so rapidly. (auth) (Canada)

10437 DIFFERENTIAL COLLISION CROSS SECTIONS AND THE INTERMOLECULAR POTENTIAL OF NEON. Williams, W.; Mueller, C. R.; McGuire, P.; Smith, B. (Purdue Univ., Lafayette, Ind.). Phys. Rev. Lett., 22: 121-3(Jan. 27, 1969).

The differential collision cross section of neon was measured and the data were used to obtain the intermolecular potential. Calculations of the macroscopic properties made using this potential are in reasonable accord with experiment. (auth)

10438 BEAM FOIL SPECTROSCOPY. Bashkin, S. (Univ. of Arizona, Tucson). Appl. Opt., 7: 2341-50(Dec. 1968).

The methods of beam–foil spectroscopy are reviewed with particular reference to the measurement of wavelengths and spectral line intensities. Photographic and photoelectric detection techniques, the methods of monitoring the beam, and Doppler effects are treated in detail. Examples are given of new spectral lines generated with the beam–foil source. 49 references. (auth)

10439 SYSTEMATIC TRENDS OF ATOMIC OSCILLATOR STRENGTHS IN ISOELECTRONIC SEQUENCES. Wiese, W. L. (National Bureau of Standards, Washington, D. C.). Appl. Opt., 7: 2361-6(Dec. 1968).

The dependence of atomic oscillator strengths (f values) on nuclear charge, which leads to systematic trends along isoelectronic sequences, is discussed with particular reference to beam-foil spectroscopy. The theoretical background for the nuclear-charge dependence is given first, and then several characteristic examples are reviewed in detail. The beam–foil technique of measuring lifetimes is one of the most important sources of data for these studies, because it readily permits reliable experimental determinations of f values over several stages of ionization within isoelectronic sequences. It is shown that experimental data are most urgently needed when f values are affected by cancellation in the transition integral or configuration-interaction effects, since in these cases most theoretical approaches run into great difficulties. (auth)

10440 MEAN LIFE MEASUREMENTS USING THE BEAM FOIL LIGHT SOURCE. Bickel, William S. (Univ. of Arizona, Tucson). Appl. Opt., 7: 2367-72(Dec. 1968).

A procedure for making quantitative measurements of the mean lives of electronic levels in beam–foil-excited ions is described. Special emphasis is given to the theoretical equations that must be fitted to data and various beam-particle monitoring techniques. (auth)

10441 CHARGE DEFLECTION EXPERIMENTS IN BEAM FOIL SPECTROSCOPY. Fink, Uwe (Univ. of Arizona, Tucson). Appl. Opt., 7: 2373-5(Dec. 1968).

The technique of static beam deflection in beam–foil spectroscopy is discussed. This technique allows the determination of the parent ionization stage of the emitting ions. A comparison between electric- and magnetic-field deflection is made. Electric-deflection experiments carried out to date are reviewed. (auth)

10442 FROZEN CORE APPROXIMATION FOR ATOMS AND ATOMIC IONS. McEachran, R. P. (York Univ., Toronto); Tull, C. E.; Cohen, M. Can. J. Phys., 46: 2675-8(Dec. 1, 1968).

Properties of the frozen-core approximation for atomic systems containing one valence electron in addition to completely filled shells are derived. It is shown that, in addition to computational convenience, the procedure enjoys certain theoretical advantages over the standard Hartree–Fock approximation. (auth)

10443 EXCITATION BY ELECTRON IMPACT OF VIBRATIONAL TRANSITIONS IN WATER AND CARBON DIOXIDE AT KINETIC ENERGIES BETWEEN 30 AND 60 eV. Skerbele, Ausma; Dillon, Michael A.; Lassettre, Edwin N. (Carnegie-Mellon Univ., Pittsburgh). J. Chem. Phys., 49: 5042-6(Dec. 1, 1968).

Vibrational excitation by electron impact, in the kinetic-energy range 30 to 60 eV, has been studied for water vapor and carbon dioxide. Intensities relative to elastic scattering have been determined at scattering angles to 15°. Fundamental vibrations are excited with much greater intensity than either overtones or combination bands, although the latter appear (weakly) in the spectra. Weak scattering in the energy-loss region 4.5 to 7.0 eV and its interpretation are discussed. (auth)

10444 NEGATIVE-ION–MOLECULE REACTIONS IN N_2O. Moruzzi, J. L.; Dakin, J. T. (Westinghouse Research Labs., Pittsburgh). J. Chem. Phys., 49: 5000-7(Dec. 1, 1968).

The relative concentrations of various negative ions present following electron attachment to N_2O have been measured as a function of pressure. The ions were identified using a quadrupole mass spectrometer coupled to a drift tube operating at pressures between 0.3 and 8 torr. The dependence on E/p of the total negative-ion current is consistent with the change from a three-body to a two-body attachment process at E/p values near 1 V $cm^{-1} \cdot torr^{-1}$. Using purified N_2O at E/p = 10 V $cm^{-1} \cdot torr^{-1}$, the O^- ions formed by attachment undergo a series of ion–molecule reactions with the N_2O to form ions with masses corresponding to NO^-, $N_2O_2^-$, NO_2^-, and $N_2O_3^-$. Several reaction schemes are considered, and a fit to the observed pressure dependence is obtained by postulating the presence of intermediate excited states of $N_2O_2^-$ and $N_2O_3^-$ with lifetimes of 4×10^{-7} and 10^{-7} sec. (auth)

10445 NATURAL ORBITALS FOR H_2. Konowalow, Daniel D.; Barker, William H.; Mandel, Richard (State Univ. of New York, Binghamton). J. Chem. Phys., 49: 5137-43(Dec. 1, 1968).

Natural-orbital (norb) expansion coefficients are presented for the LCAO–MO–SCF–CI wave function of Fraga and Ransil for separations between 1.0 and 12.0 Bohrs. These results are compared in detail with those obtained by Shull and Prosser for the He_2^{++} system. Judged at the two-norb level, the norb expansion converges faster for He_2^{++} than for H_2 at all internuclear separations. Otherwise, the norb coefficients for the two systems have quite similar dependence on scaled separations. The occurrence of more than one positive norb coefficient is found to be an intrinsic property of the approximate wave function. (auth)

10446 POSITRON ANNIHILATION IN CONDENSED AMMONIA. Holt, W. H.; Chuang, S. Y.; Cooper, A. M.; Hogg, B. G. (Univ. of Manitoba, Winnipeg). J. Chem. Phys., 49: 5147-9 (Dec. 1, 1968).

Two-photon angular correlation and lifetime studies have been performed for positron–electron pairs annihilating in liquid (–65°C) and solid (–105°C) ammonia. The angular distributions were the same for both the liquid and solid samples. A low-momentum component indicated an amount of positronium formation that is consistent with the lifetime results. The momentum distribution determined from the data is compared with a calculated distribution based on a cell model, using SCF molecular orbitals for ammonia and realistic positron wave functions. The lifetime results are discussed in the light of the free-volume model. (auth)

10447 REFLECTION AND DIFFRACTION OF He, D_2, AND H_2 FROM LiF. O'Keefe, D. R.; Palmer, R. L.; Saltsburg, H.; Smith, J. N. Jr. (Gulf General Atomic Inc., San Diego, Calif.). J. Chem. Phys., 49: 5194-5(Dec. 1, 1968).

The reflection and diffraction of He, D_2, and H_2 from the (001) plane of a LiF crystal were investigated to determine the extent to which molecular properties other than the deBroglie wavelength determine the scattering. Scattered-flux distributions are shown for 300°K beams of He and D_2 and for 300 and 600°K beams of H_2.

Comparison of the distributions for the three gases all at the same deBroglie wavelength shows that the wave properties of the incident particles do not adequately describe their scattering properties since the relative intensities in the flux distributions are quite different. The possibility of interaction of the molecular rotational states with the crystal phonons, involving inelastic energy transfer, is suggested. (A.G.W.)

10448 OBSERVATION OF SATURATION IN THREE-BODY ION-NEUTRAL ASSOCIATION REACTIONS. Bohme, D. K.; Dunkin, D. B.; Fehsenfeld, F. C.; Ferguson, E. E. (ESSA Research Labs., Boulder, Colo.). J. Chem. Phys., 49: 5201-2 (Dec. 1, 1968).

Ion-association rate constants were measured at 80°K with He as third body over the pressure range 0.1 to 3.0 torr. The rate constants for both $N_2^+ + N_2 \rightarrow N_4^+$ and $O_2^+ + O_2 \rightarrow O_4^+$ become nearly independent of He pressure. The pressure dependence of the rate constant in the N_2 case is qualitatively consistent with a picture in which N_2^+ and N_2 collide to form an unstable N_4^{+*} complex of lifetime τ, which in turn collides with He atoms. The He atoms stabilize a fraction of the N_4^+ ions. The saturation corresponds roughly to the pressure at which the He collison frequency equals the initially formed N_4^+ complex lifetime. From this it was deduced that, at 80°K, τ for N_4^{+*} is about 2×10^{-6} sec and for O_4^{+*} about 7×10^{-6} sec. (A.G.W.)

10449 CHARGE EXCHANGE IN CH_4 AND NH_3. Koopman, David W. (Univ. of Maryland, College Park). J. Chem. Phys., 49: 5203-5(Dec. 1, 1968).

Measurements of the charge-exchange cross sections for the processes $H^+ + NH_3$, $H^+ + CH_4$, $H_2^+ + NH_3$, $H_2^+ + NH_3$, $He^+ + NH_3$, $H_2^+ + CH_4$, and $He^+ + CH_4$ were made over the range 100 to 1500 eV. The cross sections were computed from the dependence of the ratio of the collected to incident current on collision chamber pressure. All the cross sections measured had appreciable values down to 100 eV, and only the $H^+ + NH_3$ cross section was found to be falling rapidly at that energy. Results are compared with the predictions of adiabatic theory. (A.G.W.)

10450 ROTATIONAL RESONANCES IN ELECTRON-DIATOM SCATTERING. Kouri, D. J. (Univ. of Houston, Tex.). J. Chem. Phys., 49: 5205(Dec. 1, 1968).

A preliminary semi-empirical study was made to determine if rotational resonances can occur in electron-diatom scattering at low energies. The results indicate that such resonances are possible in e-H_2 and e-D_2 scattering. The relative positions of the resonances agree qualitatively with those suggested by Frommhold [Phys. Rev., 172: 118(1968)] to explain his experimental results on drift velocity of electrons in D_2 and H_2. (A.G.W.)

10451 IONIZATION OF HYDROGEN, HYDROGEN DEUTERIDE, AND DEUTERIUM ON IMPACT OF METASTABLE HELIUM ATOMS. Penton, J. R.; Muschlitz, E. E. Jr. (Univ. of Florida, Gainesville). J. Chem. Phys., 49: 5083-8(Dec. 1, 1968).

Relative cross sections for the ionization of H_2, HD, and D_2 have been measured using a thermal-energy beam of 2^3S_1 and 2^1S_0 helium atoms. The cross sections for the production of H_2^+, HD^+, and D_2^+ increase in this order. The ions are observed to have average kinetic energies of at least 0.08 eV and perhaps as much as 0.3 eV. The isotope effect is explained in terms of the initial formation of a preionizing state, which may then either dissociate or ionize. (auth)

10452 KINEMATIC MODEL FOR ATOM-DIATOM REACTIONS. Suplinskas, Raymond J. (Yale Univ., New Haven). J. Chem. Phys., 49: 5046-53(Dec. 1, 1968).

A simple model for atom-diatom reactions is completely analyzed. The model represents the molecule by two hard spheres nearly in contact and the atom by a third hard sphere. Energy and momentum transfers among the three particles are calculated for all values of molecular orientation and collision parameters. On the basis of the kinematic analysis and in terms of an activation parameter, probabilities are assigned to the various reactions that may occur. Using as parameters the bond length of H_2 and the activation energy for $H + H_2$, the model predicts (a) the energy dependence of the $H + H_2$ cross section, in agreement with the complete classical analysis of Karplus et al.; (b) rate constants for hydrogen isotopic exchange reactions, which agree with experiment when threshold effects do not dominate; and (c) the hot-atom behavior of the $T + H_2$ and $T + D_2$ systems in substantial agreement with both experiment and the complete classical analysis. Methods for extending the model are discussed. (auth)

10453 POTENTIAL CURVES AND R DEPENDENCE OF ELECTRONIC TRANSITION MOMENTS FROM MOLECULAR CONTINUUM-CONTINUUM EMISSION SPECTRA. I. THEORY. Smith, Allan Laslett (Yale Univ., New Haven). J. Chem. Phys., 49: 4813-16(Dec. 1, 1968).

A procedure is developed for analyzing the oscillatory structure observed in the continuum-continuum emission of diatomic molecules when the upper state is attractive and the lower state repulsive. Given the potential curve of the lower state and the positions of the diffuse maxima and minima, the procedure uniquely determines the potential curve of the upper state. A simple semiclassical method is presented for deriving both the upper-state potential and the R dependence of the electronic transition moment from the measured relative intensity distribution. Criteria for the applicability of this method are presented and discussed. (auth)

10454 POTENTIAL CURVES FROM MOLECULAR CONTINUUM-CONTINUUM EMISSION. II. THE DISSOCIATION ENERGY OF He_2 $A^1\Sigma_u^+$. Smith, Allan Laslett (Yale Univ., New Haven). J. Chem. Phys., 49: 4817-24(Dec. 1, 1968).

The 600-Å bands of $^4He_2$ were reinvestigated photoelectrically, and the pressure, temperature, and wavelength dependence of the oscillatory structure in the region of $602 < \lambda < 710$ Å were determined. The analysis of the previous paper was applied to yield the potential curve of He_2 $A^1\Sigma_u^+$ in the range $1.5 < R < 2.4$ Å. Combination of these data with published visible spectroscopic results on this state lead to a dissociation energy $D_e(A^1\Sigma_u^+) = 2.55 \pm 0.17$ eV. The position and height of the maximum in the potential at large R have been determined as 3.0 ± 0.3 Å and 0.03 ± 0.03 eV, respectively. The A-X electronic transition moment is shown to depend only weakly on R in the range $1.7 < R < 2.15$ Å. (auth)

10455 EFFECT OF OVERLAP ON DISPERSION ENERGIES NEAR THE VAN DER WAALS MINIMUM. Murrell, J. N.; Shaw, G. (Univ. of Sussex, Eng.). J. Chem. Phys., 49: 4731-3(Dec. 1, 1968).

It is shown that a single excited configuration with optimized ζ can give accurate values of the dispersion-energy coefficients of H_2 and He_2. The resulting wave functions are then used to obtain the effect of overlap on dispersion energies. It appears that this correction is small in the region of the van der Waals minimum. (auth)

10456 HYDROGEN-ATOM POLARIZABILITY AS A HARTREE-FOCK PERTURBATION EXPANSION: A GEOMETRIC APPROXIMATION TO ATOMIC POLARIZABILITIES. Schulman, J. M. (Polytechnic Inst. of Brooklyn); Musher, J. I. J. Chem. Phys., 49: 4845-8(Dec. 1, 1968).

The hydrogen-atom dipole polarizability α is obtained by a double perturbation expansion based on a Hartree-Fock H_0. The expansion $\alpha = \alpha_0 + \lambda\alpha_1 + \lambda^2\alpha_2 + \ldots$, where λ is the continuous parameter for the Hartree-Fock perturbing potential, is found to be extremely close to a geometric series with $\alpha_{i+1}/\alpha_i = 0.433 \pm 0.002$. Computation of α as $\alpha_0[1 - (\alpha_1/\alpha_0)]^{-1}$ gives $4.499\ a_0^3$ in excellent agreement with the exact value $9/2\ a_0^3$. The origin of this geometric character is examined and its applicability to some many-electron polarizabilities is demonstrated empirically. (auth)

10457 ALKALI-ALKALI GLORY SCATTERING IN THE Σ STATE. Rothe, Erhard W.; Helbing, Reinhard K. B. (General Dynamics/Convair, San Diego, Calif.). J. Chem. Phys. 49: 4750-5(Dec. 1, 1968).

The velocity dependence of the total cross section for the scattering of ^7Li by Na, K, Rb, and Cs has been measured in a velocity range from about 1 to 4.5 km/sec, and that for Na-Cs scattering from 1 to 3 km/sec. The observed glory undulations are due to the $^3\Sigma$ state of the diatom. A Lennard-Jones (8,6) potential is assumed. The product of the potential parameters ϵr_m was obtained, and for the lithium scattering, the separated parameters ϵ and r_m were estimated. Independent of potential model, the number of extrema indicates that the minimum number of bound states for the Li-Na, Li-K, Li-Rb, Li-Cs, and Na-Cs triplet states is 3, 4, 5, 6, and 7, respectively. The Na-Cs results are not consistent with previous results. (auth)

10458 IONIZATION OF HELIUM: ANGULAR CORRELATION OF THE SCATTERED AND EJECTED ELECTRONS. Ehrhardt, H.; Schulz, M.; Tekaat, T.; Willmann, K. (Univ., Freiburg i. B.). Phys. Rev. Lett., 22: 89-92(Jan. 20, 1969).

Ionizing collisions of 114- and 50-eV electrons with helium have been studied by the measurement of the two outgoing electrons in coincidence as a function of the angle between them. At the same time the energies of the two electrons are determined. The results are compared with solutions of the Lippmann-Schwinger equation. Angular correlation distributions are found to be more sensitive for the test of a theory than energy loss and differential cross sections or the total cross section. (auth)

10459 RARE-GAS-INDUCED g_J SHIFTS IN THE GROUND STATES OF ALKALI ATOMS. Herman, Roger M. (Pennsylvania State Univ., University Park). Phys. Rev., 175: 10-13 (Nov. 5, 1968).

Based on the formal similarity between perturbations governing gyromagnetic ratio shifting and spin relaxation of alkali metal atoms in collisions with rare-gas atoms, a relatively direct semiempirical estimate of the g_J shift as a function of buffer-gas density can be achieved. The expression $\Delta g_J/g_J = -(4/3\pi)^{1/2}\, n\, \sigma_{dis}^{1/2}\sigma_{kin}$ is obtained for the fractional shift in g_J, where n is the rare-gas number density, σ_{kin} the alkali metal–rare-gas kinetic cross section, and σ_{dis} the cross section for alkali metal spin disorientation. With this relationship, a fractional g_J shift for Rb by He equal to -5.3×10^{-11} torr^{-1} is predicted, as compared with a recent value, $-(5 \pm 3) \times 10^{-11}$ torr^{-1}, obtained through measurement by Hayne, Robinson, and their coworkers. (auth)

10460 REGULARITIES IN ATOMIC OSCILLATOR STRENGTHS. Wiese, W. L.; Weiss, A. W. (National Bureau of Standards, Washington, D. C.). Phys. Rev., 175: 50-65 (Nov. 5, 1968).

Many regularities and systematic trends among atomic oscillator strengths have been studied using the extensive material recently available for the lighter elements. The quantum-mechanical background for the existence of these regularities is discussed, and in particular the relationship between oscillator strength and nuclear charge as predicted from conventional perturbation theory is reviewed in detail. A number of characteristic numerical examples are then presented. The regularities are of great practical importance, since they may be exploited to obtain additional oscillator strengths by simple interpolation techniques as well as to evaluate the reliability of existing data by the degree of fit into established systematic trends. (auth)

10461 EQUILIBRIUM CHARGE STATES OF Br AND I IONS IN SOLIDS AND GASES IN THE ENERGY RANGE 10 TO 180 MeV. Moak, C. D.; Lutz, H. O.; Bridwell, L. B.; Northcliffe, L. C.; Datz, S. (Oak Ridge National Lab., Tenn.). Phys. Rev., 176: 427-31(Dec. 10, 1968).

Monoenergetic bromine and iodine ions from the Oak Ridge tandem accelerator and an MP tandem accelerator have been used to investigate the variations of ionic charge states with various gaseous and solid target materials. In these measurements, beams containing a single charge state and energy were obtained by magnetic analysis and passed through solid targets or windowless gas targets before passing through an electrostatic analyzer. The electrostatic analyzer was fitted with a position-sensitive silicon surface-barrier detector. The most probable charge states are compared with the general relationships given by Dmitriev and Nikolaev. Strongly non-Gaussian distributions have been found at certain energies; most of these irregularities have been associated with ionic shell effects and with multiple ionization. (auth)

10462 EFFECT OF PARTICLE INTERACTION ON THE SHAPE OF THE BRAGG CURVE. Vasilevskii, I. M.; Karpov, I. I.; Prokoshkin, Yu. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 55: 2166-72(Dec. 1968). (In Russian).

The shapes of the measured and calculated Bragg curves for protons, deuterons, and α particles with momenta $\approx$1.3 GeV/c are compared. It is shown that the shape of the Bragg curve significantly depends on the geometrical conditions of the experiments and that in calculating the Bragg curve for high-energy particles interaction of particles with stopping material should be taken into account. (auth)

Cosmic Radiation

Refer also to abstracts 9725, 9737, 9739, 10532, 10565, 10788, and 10961.

10463 FLUX OF HYDROGEN, HELIUM, AND ELECTRONS AT FORT CHURCHILL IN 1967. Badhwar, G. D.; Deney, C. L.; Kaplon, M. F. (Univ. of Rochester, N. Y.). J. Geophys. Res., 74: 369-71 (Jan. 1, 1969).

The dE/dx XE detector was flown from Fort Churchill on July 7, 1967, under 2.7 g/cm^2 of residual atmosphere for a period of 14.4 hrs. The detector system was designed to measure the primary proton and helium spectra in the energy range of 70 to 220 MeV/n and with sufficient resolution to separate the isotopes of H and He. (W.D.M.)

10464 FLUX AND ENERGY SPECTRUM OF COSMIC-RAY ELECTRONS AT 42° NORTH GEOMAGNETIC LATITUDE IN OCTOBER 1967. Oran, William A.; Frye, Glenn M. Jr.; Wang, Chia Ping (Case Western Reserve Univ., Cleveland). J. Geophys. Res., 74: 53-8(Jan. 1, 1969).

The flux and energy spectrum of cosmic-ray electrons were investigated at 5.3 g/cm^2 and 2.7 g/cm^2 by use of balloons launched from Palestine, Texas, in October 1967. An 18-gap glass–metal spark chamber was used to distinguish the electron showers from the nuclear interactions. A counter telescope utilizing a gas Cherenkov counter triggered the system for particles with $E/mc^2 \gtrsim 11$. The system was calibrated with electrons of 1 to 6 BeV, and the results of this calibration were used to determine the energy of the electrons seen on the flights. The flux below 3 BeV appears to be dependent on altitude, while the flux above 3 BeV appears independent of altitude. The fluxes in the energy range of 1 to 2 BeV (2.05 ± 0.76 and 0.90 ± 0.56 electrons/m^2 sec ster BeV) agree with Verma's calculated flux of secondary electrons produced in the atmosphere. The results, which yield an integral flux of 2.72 ± 0.68 electrons/m^2 sec ster above 4 BeV, agree best with the results of Rubtsov and Zatsepin, indicating that the exponent in the equation $dN/dE = AE^{-\delta}$ electrons/m^2 sec ster BeV has a value that is closer to 3.0 than to 2.6. The proton flux was monitored periodically throughout the flights. It remained constant to within the statistical uncertainty and was equal to 603 ± 60 protons/m^2 sec ster, thus furnishing a check that the system functioned properly at altitude, and that there was no effect due to solar activity. (auth)

10465 ANALYSIS OF CHANGES IN THE MODULATED COSMIC-RAY SPECTRUM NEAR SOLAR MINIMUM. O'Gallagher, J. J. (Univ. of Chicago). J. Geophys. Res., 74: 43-52 (Jan. 1, 1969).

Direct inspection of the usual expressions for describing solar modulation as a function of particle parameters shows that changes in the form of the modulating function will result in a rigidity-dependent phase lag or "hysteresis" near solar minimum. As a means of investigating any such changes in modulation, regression analysis is performed among three groups of cosmic-ray particles: (a) 50 to 100 MeV/nucleon protons and helium nuclei, (b) the integral intensity of protons with kinetic energies >450 MeV, and (c) particles contributing to the neutron intensity at Climax. The analysis is for the period from mid-1963 to mid-1966. These analyses reveal no evidence for any hysteresis before and after solar minimum and set an upper limit of ± 0.09 for the fractional deviation of the flux of 50 to 100 MeV protons from a single valued relation with respect to the Climax neutron intensity and ± 0.02 for that of protons >450 MeV. Since the absolute fluxes of these protons vary over a range of more than 36% and 16%, respectively, in this time interval this implies that any changes in the modulating function at low rigidities (<3 GV) with respect to high rigidities (~8 GV) are less than 20% near solar minimum. This conclusion is discussed with respect to other recent observations of hysteresis effects. (auth)

10466 ANALYTIC CONTRIBUTIONS TO THE STOERMER PROBLEM. Lanzano, Paolo (North American Rockwell Corp., Downey, Calif.). Astrophys. Space Sci., 2: 319-33(Nov. 1968).

Two analytic contributions are presented to the Störmer problem (motion of a charged particle in a magnetic dipole field). The fundamental role in these considerations is played by a quantity which depends on the constant velocity of the particle: by treating this quantity or its reciprocal as a small parameter, power series solutions can be obtained for the orbit projection upon a meridian plane valid for both low-energy and high-energy particles. For high-energy particles, the zero-order approximation is in general an ellipse, but will reduce to a straight line for particular values of the integration constants. For low-energy particles, the zero-order approximation is given as an infinite series in the variable $w = \sin^2\lambda$, λ being the latitude, and it is shown that this basic orbit is not a magnetic line of force. Leading terms of the expansions have been given for the first-order approximations in both cases. Higher-order approximations can be obtained recurrently by solving linear, first-order differential equations having the same integrating factor, which depends on the zero-order approximation alone. The method is suitable for extensive numerical work in conjunction with a computer program of the 'formac' class. (auth)

10467 CALCULATIONS ON THE ARRIVAL-TIME DISTRIBUTION AND ENERGY CONTENT OF EXTENSIVE AIR SHOWERS AT LARGE CORE DISTANCES. Baxter, A. J. (Univ. of Leeds, Eng.). J. Phys., A (London), 2: 50-9(Jan. 1969).

Particles comprising an extensive air shower do not originate from a point but are produced as secondaries to the products of interactions which take place along an axial core region. Their structure or arrival-time distribution should be related to their production depth and propagation properties. A detailed Monte Carlo calculation was made on the delays arising in the development of the electron–photon component to form a basis for the

interpretation of experimental observations. Results are presented for the estimated time-delay distributions in an extensive air shower of primary energy 9×10^{15} eV at radial core distances of 200, 400, and 600 m. Also considered are the energy spectra of photons at such distances, the lateral distribution of energy in the front, and the relative muon and electron–photon contributions. (auth)(UK)

10468 ADDITIONAL CORRECTIONS TO THE METHOD OF MEASURING LINEAR POLARIZATION OF COSMIC RADIATION. Khrulev, V. V. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1473-6(1968). (In Russian).

Consideration is given to the method of simplifying in a considerable degree the discrimination of a linearly polarized component of cosmic radiation against the background of spurious effects. (auth)

10469 OBSERVATIONS OF COSMIC RADIO EMISSION NEAR GALACTIC ANTICENTER AT WAVELENGTHS OF 70, 60, AND 40 cm. Razin, V. A.; Khrulev, V. V.; Fodorov, V. T.; Volokhov, S. A.; Mel'nikov, A. A.; Paseka, A. M.; Pupysheva, L. V. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1461-72(1968). (In Russian).

A linear polarization of cosmic radiation was measured at the frequencies of 437, 510, and 735 Mc using an 8-m-diameter reflector. The region of the sky limited by the coordinates $\alpha = 1^h - 7^h$, $\delta = 58° - 70°$ (the center of the region has the galactic coordinates $l^{II} = 142°$, $b^{II} = +8°$) was investigated. The following results were obtained: (1) a degree of polarization considerably increases at the frequency of 735 Mc as compared with its values at the lower frequencies; (2) the change of the polarization degree with frequency in the directions with considerable rotation measure has a nonmonotonic character; (3) the effective rotation measure of the interstellar medium is small in the center of the region and increases to its edges; at $l^{II} > 145°$ the rotation measure is positive but at $l^{II} < 140°$ it is negative; (4) in the center of the region the degree of polarization appreciably increases with frequency at a very small variation of the position angle that indicates the complex structure of the region; and (5) the angular dimensions of the region at the 0.5 level of the polarized component increase with the increase of frequency. (auth)

10470 THEORETICAL ASPECTS ON THE COSMIC-RAY LATITUDE KNEE. Allkofer, O. C.; Dau, W. D. (Univ., Kiel). Z. Phys., 219: 234-45(1969).

Theoretical calculations are made for the latitude knee of the secondary cosmic rays. It is pointed out that there exist two latitude knees, one for the nucleonic and one for the muon component. The behavior of the latitude knee is calculated in dependence of the particle's energy, of the atmospheric depth and of the solar activity. The results are compared with known experimental facts. (auth)

10471 EQUATIONS DESCRIBING THE COSMIC-RAY GAS IN THE INTERPLANETARY REGION. Gleeson, L. J. (Monash Univ., Clayton, Australia). Planet. Space Sci., 17: 31-47(Jan. 1969).

Beginning with the Boltzmann equation, the continuity and momentum equations for the particles of the cosmic-ray gas which lie within a small energy interval are obtained. These equations are more complete than earlier versions because they include the effects of energy changes due to collisions and electric fields. The main corrections appear as a spectrum dependent factor C(r, T) (r = position vector, T = kinetic energy) which is related to the well known Compton–Getting factor. The correction terms are not negligible and have been evaluated from observational data. The equations have been used to give a more complete development of the theory of the diurnal variation of the cosmic-ray intensity; the essential physical ideas of that theory remain unchanged, but some of the components of the current density are altered and some interpretations are modified. (auth) (UK)

10472 TRAJECTORIES OF HIGH-ENERGY COSMIC RAYS IN THE GALACTIC DISK. Thielheim, K. O.; Langhoff, W. (Univ., Kiel). J. Phys., A (London), 1: 694-704(Nov. 1968).

Trajectories of high-energy cosmic-ray particles, the rigidity of which corresponds to protons of energy $E_0 = 10^{18}$ eV, were calculated numerically, using a quasi-longitudinal model of the magnetic field in the galactic disk. In this way an idea of cosmic radiation transfer at extremely high energies is obtained under specified assumptions concerning the magnetic field in the galactic disk. The galactic or extragalactic origin of particles reaching the Earth, as well as the angular distribution of such particles, is discussed. The possibility of particle transfer from the galactic center to the Earth is investigated. (auth) (UK)

10473 COSMIC RAY ELECTRONS AND GALACTIC RADIO NOISE. Sironi, G. (Univ., Milan). Planet. Space Sci., 17: 1-11(Jan. 1969).

A comparison is made between the shape of the frequency spectrum of the galactic radio background and the energy spectrum of the cosmic ray electrons. A change of slope in the energy spectrum of the electrons moving in interstellar space is to be expected between 750 MeV and 3 GeV. The most probable origin of this change of slope seems to be directly in the source of electrons of primary origin. Independently of the availability of absolute measurements of the galactic radio noise intensity and electron flux, a lower limit on the intensity of the general magnetic field, corresponding to $B \geq 4.5\ 10^{-6}$ G, can be set. (auth) (UK)

10474 MEASUREMENT OF HARD γ QUANTA AND ELECTRONS IN THE ATMOSPHERE. Chuykin, E. L; Romanov, A. M.; Lenin, A. S. (Ioffe Inst. of Physics and Tech., Leningrad). Geomagn. Aeron. (USSR (Engl. Transl.), 8: 453-4(1968).

Translated from Geomagn. Aeron., 8: 568-9(1968).

During a 200-min stay at a height of 27.7 km, the equipment recorded 19 pulses, which corresponds to a vertical intensity of I_γ (>1000 MeV) = $(1.5 \pm 0.35) \times 10^{-3} cm^{-2} \cdot sec^{-1} \cdot ster^{-1}$. The intensity of albedo electrons was found to be I_e (>200 MeV) = $(1.6 \pm 0.2) \times 10^{-3} cm^{-2} \cdot sec^{-1} \cdot ster^{-1}$ at a height of ~25 km. (W.D.M.)

Direct Energy Conversion

10475 (CEA-R-3400) STUDY OF TRANSIENT STATES IN THERMO-IONIC CONVERTERS. Landrot, Jean-Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1968. 156p. (In French). Dep. Thesis. Submitted to Univ., Paris.

In order to control a thermionic reactor, it is necessary to know the dynamic influence of four fundamental parameters: the injected thermal power, the electrical charge resistance, the temperature of the cesium, and the thermal exchange coefficient of the collector cooling circuit. The principles of the thermionic converter are briefly shown. The overriding influence of the first two parameters is shown with the help of experimental static readings. These two parameters are then made to vary in turn. The laws of variation as a function of the time, of the electrical power produced, and of the temperature of the various parts of the converter are deduced. The laboratory model of the converter was studied theoretically and experimentally, and the nuclear converter has been the subject of an analog study. This work has made it possible to make a critical comparison of the various modes of obtaining the static characteristics, and to define the principles for controlling a nuclear thermionic reactor. (auth)

10476 THERMIONIC ENERGY CONVERTERS. (to CSF–Compagnie Generale De Telegraphie Sans Fil). British Patent 1,138,953. Jan. 1, 1969. Priority date Feb. 24, 1965, France.

A thermionic converter for converting thermal energy into electrical energy is described. It comprises an enclosure filled with a vapor of an ionizable substance and contains two diodes having their interelectrode spaces in close proximity for the diffusion of ions. One of the diodes has short-circuited electrodes and is adapted to operate in the ignited mode to produce ions which diffuse into the interelectrode space of the other diode. This diode is adapted to operate in the nonignited mode and has its electrodes connected to provide the electrical energy from the converter. (M.H.R.)

10477 IMPROVEMENTS IN MAGNETOHYDRODYNAMIC INSTALLATIONS. (to Societe Generale De Constructions Electriques et Mecaniques). British Patent 1,138,788. Jan. 1, 1969. Priority date June 30, 1966, France.

A magnetohydrodynamic generator installation is described which includes an MHD duct supplied with hot gas from a combustion chamber. It also includes a chemical converter feeding said combustion chamber with the product of an endothermic chemical reaction, effected in the chemical converter, between a fuel and at least a considerable fraction of the gases from the MHD duct. The combustion chamber is also fed with superoxygenated combustion medium. (M.H.R.)

10478 WALL STRUCTURE OF MAGNETOHYDRODYNAMIC CONVERSION DUCTS AND METHOD OF FABRICATION OF SAID STRUCTURES. Yerouchalmi, David; Zettwoog, Pierre (to Commissariat a l'Energie Atomique). British Patent 1,139,375. Jan. 8, 1969. Priority date Mar. 9, 1966, France.

The invention is concerned with wall structures of MHD generators which possess the following properties: (1) thermionic emission, (2) low temperatures of insulating ceramic materials, only

the electrodes of refractory metal being permitted to attain the temperature of the gas, (3) very low thermal losses, and (4) total freedom from short-circuiting of the electrodes. Techniques for building these ducts are described. (M.O.W.)

10479 MAGNETOHYDRODYNAMIC GENERATOR. Petrick, Michael (to United States Atomic Energy Commission). U. S. Patent 3,414,744. Dec. 3, 1968.

This patent relates to a magnetohydrodynamic generator which includes an elongated duct having a flat side, a magnet which establishes a magnetic field through the duct, and means for collecting the electric current generated. The generator also includes means for directing a liquid metal onto the flat plate at an angle of between 3 and 12° and for causing the liquid metal to flow rapidly along the plate as a thin film. (AEC)

10480 AN ELECTRODE FOR A MAGNETOHYDRODYNAMIC DEVICE. (to Avco Corp.). British Patent 1,137,684. Dec. 27, 1968. Priority date July 20, 1965, United States.

An electrode is described for an MHD device of the type in which the electrode is exposed to high temperature corrosive fluids. This electrode comprises a metallic base member, one end of which is disposed adjacent the fluid; a metal which is non-oxidizing or has an electrically conductive oxide, exposed to the fluid and covering a portion of the end; and a refractory material exposed to the fluid and covering substantially the remaining portion of the end, the exposed metal being different from that of the metallic base member. (M.H.R.)

10481 MAGNETIC FIELD EFFECT UPON RESISTANCE BETWEEN THE ELECTRODES IN A CURRENT-CONDUCTING CHANNEL WITH ANISOTROPIC MEDIUM. Kulikov, V. S. Inzh.-Fiz. Zh., 15: 918-21(Nov. 1968). (In Russian).

Under conditions of magnetic circular arc, the magnetic field effects only electric conductivity of tensor nature. With the help of a modeling unit (resistance circuit) the dependence of the resistance between the electrodes on the magnetic field due to the end effects is determined in the case of plasma conductivity anisotropy within the region of arc discharge. (auth)

10482 EFFECT OF LOCAL NONEQUILIBRIUM IONIZATION IN A SEGMENTED ELECTRODE MHD GENERATOR. Haines, M. G. (Imperial Coll. of Science and Tech., London). Plasma Phys., 10: 787-97(Aug. 1968).

The electric conductivity of a seeded inert gas can be a strongly varying function of the local ohmic dissipation because of the non-equilibrium elevation of the local electron temperature and the resulting increase in the degree of ionization. Comparatively small changes in electron temperature can give rise to large changes in electron density if Saha's equation holds. It is therefore a reasonable assumption to consider the local electrical conductivity to be actually proportional to the local ohmic heating and both proportional to the local electron density. It follows that, provided the current density is everywhere orthogonal to the uniform magnetic field, the Lorentz electric field is constant in magnitude everywhere. The limitations of the theory are discussed and comparison is made with other papers. (auth) (UK)

Fluid Physics

Refer also to abstract 10597.

10483 VOLUME INTEGRALS OF THE PRODUCTS OF SPHERICAL HARMONICS AND THEIR APPLICATION TO VISCOUS DISSIPATION PHENOMENA IN FLUIDS. Higgins, Theodore P.; Kopal, Zdenek (Boeing Scientific Research Labs., Seattle, Wash.). Astrophys. Space Sci., 2: 352-69(Nov. 1968).

The equations governing the conversion of kinetic energy into heat in moving viscous media are formulated as volume integrals of products of spherical harmonics. Although the formulation of the fundamental equations is classical, difficulties in the integration of certain products of generalized spherical harmonics over a sphere have permitted heretofore the treatment of only two cases. The closed, form evaluation of eight fundamental types of definite integrals of the product of spherical harmonics, some of them new, or at least missing in the literature, makes possible for the first time the evaluation of these volume integrals in closed form for arbitrary order and index. Explicit details are given for the rates of energy dissipation produced by viscous motions characterized by spheroidal as well as toroidal symmetry. (auth)

10484 A STUDY OF THE MAGNETOGASDYNAMIC EQUATIONS AS APPLIED TO SHOCK AND BLAST WAVES. Friedhoffer, Jeffrey Alan. Newark, Del., Univ. of Delaware, 1968. 128p.

Thesis.

The one-dimensional, planar, Navier-Stokes equations as applied to magnetogasdynamic shock waves and also gas dynamic blast waves are examined. The magnetogasdynamic shock waves are studied under the assumption that the coefficients of viscosity, thermal and electrical conductivity are independent of temperature. The viscosity is assumed to be dependent on the gradient of velocity in a non-Newtonian, power law manner. The phase space of the shock equations is analyzed and these equations are numerically integrated through the shock. The dependence of the thickness of the shock on the phenomenological parameters, the downstream magnetic field, the non-Newtonian parameter and the downstream Mach number are also examined. The equations which describe flows comparable to gas dynamic blast waves are studied under the similarity transformation. The coefficients of viscosity and thermal conductivity are allowed to be functions of temperature. The equations are numerically integrated for four cases; (1) ideal flow; (2) heat conducting flow; (3) viscous flow; and (4) viscous, heat conducting flow. The magnetogasdynamic equations are transformed to the blast wave formulation via similarity techniques and appropriate boundary conditions are suggested. (Disser. Abstr.)

10485 SOME PROBLEMS OF THE THEORY OF MAGNETOHYDRODYNAMIC BOUNDARY LAYER. Zitny, K. Pr. Inst. Masz. Przeply., No. 34, 171-87(1967). (In German).

The criteria are derived for the existence of MHD boundary layers. In one case when the magnetic Reynolds number is much less than unity ($Re_m \ll 1$), the governing differential equation is a generalized Falkner–Skan equation. The existence of the solution has been proved using the method described by Coppel. An extensive bibliography on MHD boundary layers is included. (App. Mech. Rev.)

10486 EXPERIMENTAL ELECTRODE CURRENT DISTRIBUTIONS IN MHD CHANNELS. Kurz, Jerome Leigh. Stanford, Calif., Stanford Univ., 1968. 125p.

Thesis.

The distribution of current on the electrodes of a single-pair MHD channel was investigated experimentally. The experiments were performed with a flowing, atmospheric-pressure, alkali-metal-seeded argon plasma at temperatures between 1980 and 2150°K for Hall parameter values up to seven. Two electrode configurations were investigated; one with the electrodes projecting into the flowing plasma, the other with the electrodes flush with the channel wall. Qualification measurements showed that the plasma free-stream conditions were uniform across the channel and in agreement with equilibrium calculations. Results for the anode current distribution were in all cases in good agreement with the theoretical predictions. The cathode current distribution was found to agree less well with the predictions. It was observed that the cathode current distribution for flush electrodes was considerably more uniform than for projecting electrodes. The anode voltage drop was consistently a small fraction of the total applied voltage for both electrode configurations. In contrast, the cathode voltage drop for the flush electrode channel was about four times that for the projecting electrode channel and constituted nearly 50% of the total applied voltage. The cathode voltage drop was found to correlate reasonably well with the Schottky equation. Measurements made of the root-mean-square voltage fluctuations between voltage probes were consistent with the presence of magnetoacoustic and electrothermal waves. (Disser. Abstr.)

10487 THEORY OF VISCOUS COMPRESSIBLE FLOW IN A SLENDER CHANNEL WITH CROSSED ELECTRIC AND MAGNETIC FIELDS. Kitowski, John Victor. Knoxville, Tenn., Univ. of Tennessee, 1968. 231p.

Thesis.

The theoretical investigation of two-dimensional viscous compressible flow in a slender channel with crossed electric and magnetic fields is presented. An order of magnitude analysis is performed which allows the magnetohydrodynamic form of the Navier–Stokes equations to be reduced to a parabolic system of nonlinear partial differential equations. The resulting equations are solved by numerical techniques with employment of the Flügge–Lotz and Blottner implicit finite difference procedure which is modified for internal flows. Numerical solutions are compared with exact solutions for the case of non MHD flow. Several cases of MHD flow are investigated for both low and high values of Reynolds number. Results of this study may be summarized as follows: (1) solutions to the governing equations for MHD slender channel flow have been obtained and exhibit characteristics compatible with the physical phenomena of the problem

(2) the finite-difference integration technique appears to yield accurate results as demonstrated by comparison of numerical and exact solutions and (3) a method of determining the unknown pressure distribution for internal flows has been developed. (Disser. Abstr.)

10488 ARBITRARY TWO-DIMENSIONAL PROFILE OF VELOCITY IN A SEGMENTED MHD DUCT. Haines, M. G. (Imperial Coll. of Science and Tech., London). Plasma Phys., 10: 803-5(Aug. 1968).

An averaging procedure reduces the problem to an analytically tractable set of equations and boundary conditions of the same form as the two-dimensional problem solved previously. (UK)

Geophysics

Refer also to abstract 10402.

10489 ISSLEDOVANIE POLYARNYKH SIYANII I VERKHNEI ATMOSFERY RADIOFIZICHESKIMI METODAMI. POLYARNYE SIYANIYA NO. 15. (Studies of Aurorae and Upper Atmosphere by Radiophysical Methods. Auroral No. 15). Ponomarev, E. A.; Vershinin, E. F. Results of Researches on the International Geophysical Projects. Moscow, Izdatel'stvo-Nauka, 1967. 84p.

The work presents, in two parts, the results of the study of sporadic ionization zones associated with aurora and ultralow-frequency radio emission in the auroral zone. The first part suggests a physical model of the ray arc of aurora. Further, on the basis of parameters calculated according to that model, the study of conditions of origination of diffusion quasi-neutral waves in the auroral plasma is carried out. These waves are assumed to cause the diffusion of the ultrashort waves signals. The radar equipment is described which was used to observe radio reflections from the zones of sporadic ionization in 1964–65 in Yakutsk. Major results of these observations are given. The second part describes the equipment which carried out observations of continuous ultrashort emission in 1962–65 in the Tixie Bay region. A classification is given of an ultrashort emission, as well as the description of the connection between each type of emission and other geophysical phenomena. The work also provides an evaluation of the energy flows of the ultralow frequency in several frequency bands and gives suggestions about the nature of isolated sound bursts. (auth)

10490 RESOLUTION OF THE QUESTION OF PRESSURE DEPENDENCE OF THE RATE OF FORMATION OF N_4^+. Varney, R. N. (Lockheed Palo Alto Research Lab., Calif.). J. Geophys. Res., 74: 398-9(Jan. 1, 1969).

Warneck (1967a,b) reported that the rate of formation of N_4^+ ions in nitrogen by the process, $N_2^+ + N_2 \rightarrow N_4^+$, depended on the square of the pressure of nitrogen, indicating a three-body collision mechanism for the process. The author (1967) questioned the validity of the finding. The primary purpose of this letter is to advise readers that the author now finds Warneck's data to be correct and to withdraw the disagreement expressed (Varney 1967). (W.D.M.)

10491 CONFLICTING ELECTRON TEMPERATURE MEASUREMENTS IN THE UPPER F REGION. Hanson, W. B. (Southwest Center for Advanced Studies, Dallas, Tex.); Brace, L. H.; Dyson, P. L.; McClure, J. P. J. Geophys. Res., 74: 400-1(Jan. 1, 1969).

It is pointed out that a discrepancy exists between values of electron temperature obtained from the Langmuir probe experiments on Explorer 32 and the Jicamarca Radar Observatory. Essentially, the problem is that values of T_e derived from the two identical cylindrical probes are in agreement but are consistently higher than those derived from the radar data. (W.D.M.)

10492 DISCUSSION OF LETTER BY PETER M. BANKS AND J. WILLIAM McGOWAN, "He_2^+ IN THE TOPSIDE IONOSPHERE." Ferguson, E. E.; Fehsenfeld, F. C. (ESSA Research Labs., Boulder, Colo.). J. Geophys. Res., 74: 402-4(Jan. 1, 1969).

In a recent letter to this Journal, Banks and McGowan (1968) proposed that ions observed above 500 km by Hoffman (1967) with a mass-to-charge ratio of 8 amu/unit charge may be He_2^+, rather than O^{2+}. It is the purpose of this letter to point out that Banks and McGowan seriously overestimated the possible production of He_2^+ and underestimated the He_2^+ loss, thus seriously overestimating the possible He_2^+ concentration. A reply by Banks and McGowan is included in which they concur with these conclusions. (W.D.M.)

10493 DISCUSSION OF A LETTER BY A. L. OSTER AND S. C. CORONITI, "A METHOD OF MEASURING ELECTRON AND ION DENSITIES IN THE REGION OF 40 TO 80 KILOMETERS". Dolezalek, H. (Office of Naval Research, Washington, D. C.). J. Geophys. Res., 74: 405-7(Jan. 1, 1969).

The author makes several cautionary remarks which he thinks are applicable if the ion mobility spectrometer as used by Oster and Coroniti (1968) is to be used for counting electrons and negative ions. A reply by Oster and Coroniti is included. (W.D.M.)

10494 FORMATION OF N_4^+ IN NITROGEN. Warneck, Peter (GCA Tech. Div., Bedford, Mass.). J. Geophys. Res., 74: 396-7 (Jan. 1, 1969).

Due to a difference of opinion on whether the $N_2^+ + N_2 \rightarrow N_4^+$ is a two-body or three-body process, a new set of experiments was performed with the photoionization technique, following the suggestions by Varney (1967) that the parameter E/p, the ratio of the electric field strength to the pressure, be kept constant in the ion source so that the energy of the reacting ions remains unchanged. The new results and their implications are discussed. (W.D.M.

10495 CONJUGACY OF VISUAL AURORAS DURING MAGNETICALLY QUIET PERIODS. Belon, A. E. (Univ. of Alaska, College); Maggs, J. E.; Davis, T. N.; Mather, K. B.; Glass, N. W.; Hughes, G. F. J. Geophys. Res., 74: 1-28(Jan. 1, 1969).

The spatial and temporal conjugacy of auroras at high latitudes has been investigated by flying two NC-135 jet aircraft, equipped with all-sky and narrow-field cameras, along magnetically conjugate paths crossing the northern and southern auroral zones along the dipole 256° meridian. The flights were centered about magnetic midnight on March 12, 14, and 16, 1967. Magnetic activity was very low throughout this period; nevertheless, auroras were observed between dip latitudes 68° and 71° during each flight. A visual examination of all the data and a quantitative analysis of selected film frames indicate that, within the limits of error in the measurements and aircraft navigation, all the observed auroras were conjugate according to the GSFC 12/66 model of the main geomagnetic field. In most cases when the relative positions of aircraft and aurora were the same in both hemispheres, the conjugate auroras exhibited remarkably detailed similarity (point conjugacy) in their shape, intensity, and in their spatial and temporal variations. There is a tendency for the southern auroras to be located slightly eastward of the northern conjugate auroras. Such a displacement appears to be consistent with a slight asymmetric distortion of the main geomagnetic field due to solar-wind pressure and Earth dipole–Sun geometry at the date and time of the measurements. These results suggest that, during magnetically very quiet times, auroras located at dip latitudes up to 71° are caused by a symmetrical injection of electrons and protons near the equatorial plane and onto magnetic field lines that are closed, stable, and relatively undistorted by external magnetic fields. Preliminary results from similar conjugate flights conducted during March 1968, a magnetically disturbed period, are briefly described. A visual inspection of these data has revealed substantial deviations in auroral conjugacy and a considerably more complex behavior of particle precipitation than that occurring during magnetically quiet periods. (auth)

10496 ENERGETIC ELECTRONS OF TERRESTRIAL ORIGIN BEHIND THE BOW SHOCK AND UPSTREAM IN THE SOLAR WIND. Anderson, K. A. (Univ. of California, Berkeley). J. Geophys. Res., 74: 95-106(Jan. 1, 1969).

Energetic electron fluxes associated with the Earth's bow shock are found to be present about as often on the dawn side of the Sun–Earth line as on the dusk side. The peak fluxes attained by these spikes also show no dawn-dusk asymmetry. Upstream electron events, on the other hand, are predominantly found to the dawn side of the Sun–Earth line. Both phenomena have the same temporal character with characteristic times of 30 to 150 seconds. Both have characteristic energies of about 15 keV, both the upstream electron fluxes are much weaker. The upstream events are interpreted to be of secondary origin with the bow shock spikes representing the primary acceleration event. This local acceleration process evidently is of no consequence to the problem of the Van Allen belts and auroral processes. (auth)

10497 HYDROGEN GEOCORONA AND SOLAR LYMAN-ALPHA LINE. I. ROCKET MEASUREMENT OF THE SOLAR LINE PROFILE. Bruner, Elmo C. Jr.; Parker, Robert W. (Univ. of Colorado, Boulder). J. Geophys. Res., 74: 107-13 (Jan. 1, 1969).

A rocket-borne high-resolution echelle spectrograph was used to measure the profile of the solar-hydrogen Lyman-alpha line. The profile was normalized to an integrated flux of 5.2 ergs/cm^2 sec, the value of which was measured with a nitric oxide ion chamber carried on the same flight. The flux available for scattering by hydrogen in the geocorona was 2.8×10^{11} photons/cm^2 sec. The optical depth at the center of the telluric absorption line

was about 5.6 in the slant path at a 60° zenith distance. The general features of the profile are in agreement with earlier measurements. (auth)

10498 STRUCTURE OF THE NEUTRAL SHEET IN THE GEOMAGNETIC TAIL. Laird, M. J. (Univ. of New Hampshire, Durham). J. Geophys. Res., 74: 133-9 (Jan. 1, 1969).

In early 1963, Explorer 14 (apogee about 16 R_E) made magnetic field measurements at the earthward end of the geomagnetic tail. On several occasions the field was observed to reverse direction in times of the order of a minute, corresponding to passages through the so-called neutral sheet. Two of these passages, on February 10 during a moderately severe storm, are analyzed in detail. The orientation of the sheet is discussed, and it is shown how field lines may be computed from the measurements. It is found that on both occasions the field lines were connected through the sheet, with normal components of several gammas. No evidence is found of the two standing shock waves proposed by Axford, Petschek, and Siscoe. Immediately after one encounter with the sheet, the field had a southward component of up to 30 γ for over a minute. At about the same time, ground stations recorded the onset of a magnetic bay. It is suggested that this observation by the satellite was made on the far side of a region in which field line reconnection was taking place. (auth)

10499 OBSERVATIONS OF LOWER HYBRID RESONANCE PHENOMENA ON THE OGO 2 SPACECRAFT. Laaspere, T.; Morgan, M. G.; Johnson, W. C. (Dartmouth Coll., Hanover, N. H.). J. Geophys. Res., 74: 141-52 (Jan. 1, 1969).

Audiofrequency noise bands of continuous and triggered types that are evidently associated with the lower hybrid resonance frequency of the ionospheric medium have been observed with Dartmouth's whistler receiver using a 9-ft electric dipole antenna on the OGO 2 spacecraft at heights up to 1500 km (apogee) and at frequencies up to 18 kHz (upper cutoff of the broadband receiver). Previous reports of observations of such bands have all been from the Alouette satellites that also carry whistler receivers equipped with electric dipole antennas. Although the electric dipole on OGO 2 is much shorter than the antennas of Alouette, the results are similar to the Alouette observations. A direct comparison is made of records obtained simultaneously on OGO 2 by Stanford's vlf experiment, which is connected to a loop antenna, and it is shown that triggered LHR emissions are seen almost exclusively on the experiment with the electric dipole antenna, pointing to an electric character of the waves. A new observation made is that the upper cutoff frequency of the lower hybrid resonance noise bands triggered by fractional-hop whistlers occasionally displays an envelope that has the shape of an Eckersley whistler. Whereas the results of the experiment are consistent with the interpretation that the lower cutoff frequency of noise bands triggered by whistlers in the lower hybrid resonance frequency of the ionosphere in the vicinity of the satellite, there is at present no satisfactory explanation of the upper cutoff. (auth)

10500 LATITUDINAL DISTRIBUTION OF AURORAL AND AIRGLOW EMISSIONS: THE "SOFT" AURORAL ZONE. Eather, R. H. (Rice Univ., Houston, Tex.). J. Geophys. Res., 74: 153-8 (Jan. 1, 1969).

A photometric latitude survey in the northern hemisphere was made from a jet aircraft to study atmospheric emissions. No diffuse, particle-excited emissions were detected above 80° invariant latitude at night during January through March 1968, and an upper limit on the energetic-particle energy influx during this period is therefore calculated to have been $\sim 2 \times 10^{-3}$ erg cm^{-2} sec^{-1} (for both protons and electrons). Soft electrons with energies ~0.6 keV precipitate in a zone that is located poleward of the normal auroral zone, resulting in a zone of enhanced λ6300 O I emission. Averaged latitudinal distributions for Hβ, λ4278 N_2^+, λ5577 O I, λ6300 O I, and λ5890-96 Na between 13°N and 87°N geom. are presented, and their significance relevant to direct satellite measurements of particle fluxes is discussed. (auth)

10501 ORIGIN OF DRIFT-PERIODIC ECHOES IN OUTER-ZONE ELECTRON FLUX. Brewer, H. R.; Schulz, Michael; Eviatar, Aharon (Bell Telephone Labs., Murray Hill, N. J.). J. Geophys. Res., 74: 159-67 (Jan. 1, 1969).

The time-dependent flux of equatorial electrons (0.4 MeV $\lesssim E \lesssim$ 2.2 MeV) observed on ATS 1 often exhibits drift-periodic structures that can be traced back to a sudden expansion or compression of the magnetosphere. The magnetospheric disturbance redistributes the energetic electrons among drift shells in an asymmetrical manner, and this spatial asymmetry between noon and midnight reveals itself as a temporal variation in particle flux as the electrons subsequently drift past the observer. A mathematical model for the dynamics of the azimuthal bunching of energetic electrons reveals the microstructure of the redistribution of electrons among drift shells and indicates qualitatively the relation of this microstructure to the diffusion of particles across L. (auth)

10502 BOUNCE-RESONANT SCATTERING OF AURORAL-ZONE ELECTRONS. Eviatar, Aharon; Schulz, Michael (Bell Telephone Labs., Murray Hill, N. J.). J. Geophys. Res., 74: 169-82 (Jan. 1, 1969).

Geomagnetically trapped electrons having mirror points in the auroral ionosphere may experience temporally periodic forces exerted by magnetosonic oscillations occurring at discrete frequencies there. The effects of these forces build up systematically with time for those particles having bounce periods that are integer multiples of an oscillation period. As a result of this bounce-resonant scattering, particles tend to accumulate in bunches along the field line, i.e., to become bunched in bounce phase, as the mirror points are driven toward the dense atmosphere. The phase bunching may contribute to the formation of auroral microbursts, and the scattering mechanism may enhance mirror-point diffusion of the resonant particles. (auth)

10503 DIRECT IN SITU MEASUREMENTS OF WAVE PROPAGATION IN THE NEUTRAL THERMOSPHERE. Newton, George P.; Pelz, David T.; Volland, Hans (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 74: 183-96 (Jan. 1, 1969).

The density gages on the Explorer 32 satellite have measured local variations in the atmospheric density that confirm that waves propagate in the neutral atmosphere. The waves were observed in the northern hemisphere over the altitude range from 286 km (satellite perigee) to at least 510 km. The waves are most prevalent at the higher latitudes near the auroral zone (orbit inclination is 65°) and were observed most frequently in the late evening and early morning hours, but were not limited to these latitudes and times. The apparent vertical half-wavelengths of the waves increase with altitude from 1 km at 286-km altitude to 70 km at 510-km altitude. Apparently four integrally related wavelengths have been observed, a "fundamental" and the second, third, and fourth harmonics. The wave density perturbation half-amplitudes range from the limit of detectability to the largest observed of 50% of the smoothed density profile value. These waves are interpreted as free internal gravity waves propagating predominantly north–south, or south–north, with maximum horizontal wavelengths between 130 and 520 km. The altitude dependence of the apparent vertical half-wavelengths results from the satellite moving with varying vertical velocity through a slowly propagating wave pattern with nearly vertical phase planes. This interpretation is consistent with observations of large-scale traveling ionospheric disturbances by Thome and Georges. (auth)

10504 GRAVITY WAVES OBSERVED BY IONOSPHERIC TEMPERATURE MEASUREMENTS IN THE F REGION. Harris, K. K.; Sharp, G. W.; Knudsen, W. C. (Lockheed Palo Alto Research Lab., Calif.). J. Geophys. Res., 74: 197-204 (Jan. 1, 1969).

Ion temperature measurements below the F peak have revealed the presence of a fine structure in the ionospheric temperature. The measurements were made with an ion energy analyzer carried aboard a low-altitude polar-orbiting satellite. The temporal resolution of the ion energy analyzer was 3 seconds corresponding to a horizontal spatial resolution of approximately 23 km. At the altitudes of these measurements the ions and neutral species of the atmosphere have a common temperature; thus the temperature structure present in the ion temperature must also be present in the neutral atmosphere as well. The temperature structure is observed to have a wave-like character with wavelength of the order of 200 km. The fractional temperature variation is typically 13%. Much of the observed wave structure is interpreted as internal atmospheric gravity waves, and the results obtained here are compared with the existing theory. A large portion of the wave structure observed cannot be explained on the basis of the simple linearized gravity-wave theory. This wave structure is either the result of some as yet unspecified phenomenon or is the result of gravity waves in a real atmosphere where the idealized conditions and restriction from linearization are removed. (auth)

10505 Pc 1 MICROPULSATION ACTIVITY AND MAGNETOSPHERIC AMPLIFICATION OF 0.2- TO 5.0-Hz HYDROMAGNETIC WAVES. Criswell, David R. (Rice Univ., Houston, Tex.). J. Geophys. Res., 74: 205-24 (Jan. 1, 1969).

A model of hydromagnetic-wave amplification in the magnetosphere is presented that permits a consistent interpretation of several general and specific features of Pc 1 micropulsation activity (0.2 Hz $\lesssim f \lesssim$ 5 Hz). It has been found that (1) micropulsations with 0.2 Hz $\lesssim f \lesssim$ 5 Hz originate preferentially in the magnetospheric regions of maximum amplification; (2) the com-

plete frequency range is amplified in the plasmasphere whereas the plasma trough amplification is limited to the 0.3 Hz $\lesssim f \lesssim$ 1 Hz range; (3) the μ = 10 to 100 MeV/gauss protons amplify only the 0.2 Hz $\lesssim f \lesssim$ 5 Hz primary hm waves. Several properties of the μ = 10 to 100 MeV/gauss protons are implied on the basis of micropulsation activity. The amplification mechanism is cyclotron resonance between left-hand polarized hm waves and the energetic component of the magnetospheric proton population. Spatial and energy distributions of the magnetospheric proton population and a model of the bounded geomagnetic field that are consistent with experimental observations are utilized in the amplification model. (auth)

10506 MEASUREMENTS OF THE AFTERNOON RATIO AURORA AT 1295 MHz. Abel, W. G. (Massachusetts Inst. of Tech., Lexington); Newell, R. E. J. Geophys. Res., 74: 231-45 (Jan. 1, 1969).

Afternoon radio aurora was observed on 26 days out of 54 during the period May 1965 to January 1966, with the Millstone Hill radar. The completely steerable 84-foot-diameter antenna provided a 0.6° half-power beamwidth at 1295 MHz. Echoes were obtained at azimuths within ±30° of the magnetic meridian (345°T) and at elevation angles up to 13°. They were returned from a layer-like region having a thickness of 5 to 20 km and located at an average height near 110 km. The echoes are strongly aspect sensitive, and none were obtained from regions where the aspect angle was greater than about 3°. Both the occurrence of auroral echoes and the southernmost limit of the echo region were found to correlate with the magnetic index Kp. The Doppler spectra of the echoes show predominantly approaching velocities to the east of the magnetic meridian and receding velocities to the west. The magnitude of the Doppler offset and the variation of offset with azimuth favor the two-stream plasma instability theory of Farley as an explanation of auroral echoes. The direction of plasma wave motion together with the variation of electrojet current with altitude may explain the presence of echoes at the magnetic meridian (not expected from the Farley theory for an east–west current). (auth)

10507 SOURCE FOR FIELD-ALIGNED CURRENTS AT AURORAL LATITUDES. Schield, M. A.; Freeman, J. W.; Dessler, A. J. (Rice Univ., Houston, Tex.). J. Geophys. Res., 74: 247-56 (Jan. 1, 1969).

Energetic plasma drifting toward the Earth from the plasma sheet in the magnetotail is terminated by an inner boundary (the Alfvén layer). Sheets of field-aligned current (Birkeland currents) flow down to the ionosphere from this plasma boundary. The mechanism for generating the current is essentially that originally proposed by Alfvén in 1939. A certain amount of charge separation develops in the Alfvén layer because the geocentric drift paths of ions and electrons are not coincident within the layer. The charge separation produces an electric field that is perpendicular to B and is transmitted along lines of force to the ionosphere. Currents flow across magnetic field lines in the ionosphere and along the magnetic field lines to the Alfvén layer. The electric field is reduced by these currents, which flow to neutralize the charge separation. The position of the Alfvén layer is such as to produce a current sheet that enters the ionosphere at auroral latitudes. The Birkeland current necessary to neutralize the Alfvén layer is calculated to be about 10^6 amps, which is sufficient to produce the transverse magnetic disturbances of about 100 γ that have been observed by satellites in auroral latitudes; the thickness of the Alfvén layer corresponds to the width of the zone of these transverse magnetic disturbances. Finally, the Birkeland current is related to a larger current system that includes the DS current system. (auth)

10508 MEASUREMENTS OF ELECTRON COOLING RATES IN THE MIDLATITUDE AND AURORAL-ZONE THERMOSPHERE. Brace, L. H. (Goddard Space Flight Center, Greenbelt, Md.); Mayr, H. G.; Carignan, G. R. J. Geophys. Res., 74: 257-66 (Jan. 1, 1969).

Two day–night pairs of thermosphere probe rockets, launched at Wallops Island, Virginia, in March 1965 and at Churchill, Manitoba, in November 1965 have provided altitude profiles of electron temperature and concentration at midday and midnight. Altitude profiles of N_2 measured on the same four flights have in addition provided neutral gas temperature profiles. These data are employed to calculate electron cooling rate profiles, and these in turn are interpreted in terms of ionospheric heat sources. The daytime electron heat source for the F region, at both middle latitudes (L = 2.9) and in the auroral zone (L ≈ 8), appears consistent with solar ultraviolet heating. The nighttime F region, however, appears to be heated by downward conduction from the protonosphere at middle latitudes and by particle heating in the auroral zone. The source of electron heating for the E region both day and night and at both locations cannot be explained by direct solar heating. This may be produced by neutral winds, electric currents, an unknown chemical reaction or, as Walker has suggested, selective heating of the electrons by excited N_2 having lifetimes in the E region of the order of a day. (auth)

10509 MIDLATITUDE NEUTRAL THERMOSPHERE DENSITY AND TEMPERATURE MEASUREMENTS. Pelz, David T.; Newton, George P. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 74: 267-71 (Jan. 1, 1969).

An ensemble of six independent aeronomy experiments was launched from Wallops Island, Virginia, on March 2, 1966, at 1300 EST. Two Bayard–Alpert ionization gages, similar to those on the Explorer 17 satellite, were flown to measure neutral atmospheric density and temperature. However, the Bayard–Alpert gages appear to have pumped or adsorbed virtually all of the atmospheric atomic oxygen (O) to which they were exposed, and thus measured only the molecular nitrogen, molecular oxygen, and helium in the region from 150- to 450-km altitude. Deduced N_2 number densities (1.9×10^{10}, 3.5×10^{7}, and 1.9×10^{5} particles cm^{-3} at 150, 300, and 450 km, respectively) agree with nearly simultaneous measurements obtained from a neutral mass spectrometer and a solar euv extinction experiment. Previous N_2 measurements from thermosphere probes, obtained under similar solar and geomagnetic conditions, agree well with these data. An exospheric temperature near 875°K was determined for the 1300 hour local solar time atmosphere. The O pumping, presumably by initially oxygen free surfaces in the Bayard–Alpert gages, is discussed and contrasted to the oxygen processed surfaces in the magnetron gages flown on the Explorer 17 and 32 satellites, which apparently did not pump the ambient O. (auth)

10510 DOPPLER SHIFTS ON HIGH-FREQUENCY GROUND BACKSCATTER. Agy, Vaughn (ESSA Research Labs., Boulder, Colo.). J. Geophys. Res., 74: 273-7 (Jan. 1, 1969).

Frequency changes (Doppler shifts) of high-frequency radio waves propagated by a changing ionosphere can be observed and measured both for ground backscatter and for "point-to-point" circuits. However, the relationships between ionospheric change and frequency shift are different in the two cases. The nature of the difference is indicated here by use of simple ionospheric models. Analogously, ionospheric dispersion (variation with frequency rather than time) shows itself differently in the two cases. Consequently, the well-known group path, phase path relationship $P' = P + f(dP/df)$ does not hold for ground backscatter in which observations are made at a fixed time delay. (auth)

10511 DIURNAL VARIATION OF NEUTRAL AND CHARGED PARTICLE TEMPERATURES IN THE EQUATORIAL F REGION. McClure, J. P. (Jicamarca Radar Observatory, Lima). J. Geophys. Res., 74: 279-91 (Jan. 1, 1969).

Thomson scatter electron and ion temperature (T_e and T_i) profiles from Jicamarca, Peru, near the magnetic equator are discussed. The temperature of the neutral atmosphere (T_n) can easily be deduced from T_e and T_i measurements made near the equator because $T_e - T_n$ is small (near 0°K at night; near 100°K around 400 km by day). The diurnal variation of T_e and hence of T_n at 400 km is as follows: T_e increases at an almost constant rate of about 16°K/hr from about 0800 to 1600 hr, then decreases rapidly near sunset. It decreases at an almost constant rate of about 10°K/hr from about 2100 hr until sunrise. The diurnal variations of Q_{ei}, the electron–ion heat transfer rate, are found to be consistent with the T_n variations deduced; e.g., the measured Q_{ei}, which is approximately proportional to n(O) at 300 km, reaches a maximum about 1600 hr, as does T_n. Daytime T_e and T_i values are nearly equal and constant over an altitude range of 100 to 200 km near and above the electron concentration (N_e) maximum. Theory predicts $T_e - T_i$ will decrease, and $T_i - T_n$ will increase with height, with T_e nearly constant, if the N_e profile is as broad as usual near the magnetic equator. Nighttime T_e and T_i values are nearly equal and constant over the 200- to 1000-km altitude range. Thus the nighttime heat input is unmeasurably small, less than a few eV/cm^3 sec in the equatorial F region. (auth)

10512 A STUDY OF POLAR MAGNETIC SUBSTORMS. Akasofu, S.-I.; Meng, C.-I. (Univ. of Alaska, College). J. Geophys. Res., 74: 293-313 (Jan. 1, 1969).

The changing distribution of magnetic disturbance vectors of a polar magnetic substorm that occurred on December 16, 1964, is examined in detail by analyzing records from more than 70 stations in the northern hemisphere. The distribution of the observed magnetic disturbance vectors at about the maximum epoch of the substorm is found to be similar to that obtained by Silsbee and Vestine, except for some details in the auroral latitudes. Since magnetic observations made by satellites strongly suggest, however, that the equivalent current system for substorms, such as that constructed by Silsbee and Vestine, cannot be interpreted as

being ionospheric, a model current system that is similar to that proposed by Alfvén and Fejer is considered. In the model, extra-ionospheric currents flow along the field lines (the field-aligned current), into the auroral latitude, inward in the morning sector and outward from the evening sector, after flowing along the auroral ionosphere (the Cowling current). A model calculation, which is a slightly modified version of one by Kirkpatrick, shows that at the maximum epoch of the substorm the model current system can reasonably reproduce the observed distribution below dipole latitude 55°. However, it is pointed out also that this model current system is too simple to reproduce the observed distribution in the auroral latitude and the polar cap. A large-scale Hall current system, as well as the Cowling current, is likely to be generated in the ionosphere, as pointed out by Fejer, Swift, and Atkinson. It is concluded thus that both the field-aligned Cowling and Hall currents should be considered together to account for the distribution of magnetic disturbance vectors over the entire Earth's surface and in space. (auth)

10513 NIGHTTIME TOPSIDE IONIC COMPOSITION AND TEMPERATURE OVER ARECIBO, PUERTO RICO. Moorcroft, D. R. (Univ. of Western Ontario, London). J. Geophys. Res., 74: 315-24 (Jan. 1, 1969).

The ionic composition and temperature of the nighttime ionosphere over Arecibo, Puerto Rico, have been deduced from Thomson (incoherent) scatter spectra obtained with the radar at the Arecibo Ionospheric Observatory on seventeen nights between August 1965 and August 1966. At no time was more than 20% He^+ detected at any height. In general, the transition from O^+ to H^+ was low (475 km) and abrupt in the winter and higher (675 km) and more gradual in the summer. Typically, the transition level (height where $\%O^+ = \%H^+$) lowered progressively during the summer nights, but showed a post-sunset increase during the winter nights. Analysis of this post-sunset increase indicates that it was due to a general increase in the height of the topside ionosphere, which occurred too rapidly for chemical equilibrium to be established. The resulting time constants imply a charge-exchange cross section of less than 9×10^{-16} eV cm^{-2} sec^{-1}, a value smaller than previously assumed. The data for one winter night were analyzed in detail. An estimate of the downward heat flux agrees in magnitude and time variation with previous theoretical results on the cooling of the protonosphere. The composition profiles seem to imply a downward H^+ flux comparable with estimates of the theoretical limit. However, observations at other times of the year suggest that other (unknown) effects may complicate the interpretation of composition profiles. (auth)

10514 THE EFFECT OF BANDWIDTH ON THE INTERPRETATION OF THE CROSS SPECTRA OF WAVE RECORDINGS FROM SPATIALLY SEPARATED SITES. Gossard, Earl E. (Naval Electronics Lab. Center, San Diego, Calif.). J. Geophys. Res., 74: 325-37 (Jan. 1, 1969).

It is argued that the coherence between records from a triangle of stations can be used to deduce not only the effective beamwidths of gravity wave patterns but can also be used to obtain their velocity bandwidth throughout the wave spectrum and its effect on the apparent velocity of propagation. Relationships between the apparent velocity of wave propagation and the velocity bandwidth are derived; they are analogous to the cross correlation approach of Briggs, Phillips, and Shinn but are herein generalized to include the frequency domain. The significance of the similarity hypothesis which is essential to the Briggs, Phillips and Shinn approach is discussed. The effect of the frequency bandwidth corresponding to the sampling rate and digital methods of analysis is considered in relation to the apparent phase velocity. The analytical results are applied to experimental data on gravity wave motions in the D region of the ionosphere. (auth)

10515 SEASONAL VARIATION OF IONOSPHERIC WINDS OVER BARBADOS, WEST INDIES. Murphy, Charles H. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). J. Geophys. Res., 74: 339-47 (Jan. 1, 1969).

With the completion of the wind data reduction of the two eight-trail nights in September 1966 and February 1967, an analysis of the seasonal variation can be made of the complete set of six multitrail nights. A remarkable feature of the wind profiles measured in September 1966 was the predominance of a wind direction clockwise rotation with increasing altitude. This rotation has been frequently observed at temperatue latitudes but has occurred for only three isolated Barbados profiles of the previous analyzed group of 49 profiles. Although substantial fluctuation in zonal flow was observed throughout a night, the mean nocturnal profiles show surprising consistency. A pair of mean zonal profiles for September nights a year apart showed good agreement, and a pair of February profiles showed excellent agreement. These nocturnal mean profiles indicated a monsoonal reversal between September and winter flows and a null point for zonal flow at 105 km. (auth)

10516 EVIDENCE THAT THE PLASMA SHEET IS THE SOURCE OF AURORAL ELECTRONS. Chase, L. M. (Univ. of California, Berkeley). J. Geophys. Res., 74: 348-50 (Jan. 1, 1969).

High-resolution energy measurements were made on electrons and protons precipitating into the auroral zone using three sounding rockets. The results are compared with measurements made by satellites in the magnetotail. Evidence is presented indicating that the plasma sheet is the source of energetic electrons during auroral breakup. (W.D.M.)

10517 THE AURORAL ELECTRON ENERGY SPECTRUM EXTENDED TO 45 eV. Westerlund, L. H. (Rice Univ., Houston, Tex.). J. Geophys. Res., 74: 351-4 (Jan. 1, 1969).

A recent observation of the auroral electron spectrum extended to 45 eV is reported, which reveals the existence of a smooth continuum from which the 6-keV peak emerges to produce the auroral arcs. The observations were obtained from the Rice Univ. Javelin Twins 1 sounding rocket experiment launched to an altitude of 800 km over an active IBC I-II aurora from Fort Churchill at 2347 LT, March 17, 1967. (W.D.M.)

10518 EARLY DETECTION AT LOW LATITUDES OF A POLAR CAP EVENT BY ITS EFFECT ON VLF PROPAGATION. Crary, J. H.; Diede, A. H. (Ionospheric Telecommunications Lab., Boulder, Colo.). J. Geophys. Res., 74: 362-5 (Jan. 1, 1969).

Energetic solar protons produce effects on the ionosphere that may be generalized by the term polar cap event (PCE). The effect of PCE on vlf propagation has been reported by several investigators. The usefulness of vlf measurements has perhaps been somewhat reduced by the advent of satellite-borne particle detectors, which can now record the energetic particles directly, with a low threshold. The measurements reported in this paper, however, indicate that as proposed by Reid (1966), the vlf techniques may be extremely sensitive to low proton fluxes. (W.D.M.)

10519 THE RATIO $\rho(5577)/\rho(N_2^+$ FIRST NEGATIVE) IN THE AURORA. Murcray, Wallace B. (Univ. of Alaska, College). J. Geophys. Res., 74: 366-8 (Jan. 1, 1969).

The horizontal intensity variation present in the two sets of observations discussed here may or may not be present in all auroral forms. To compare the present results with other observations such as those made by Cummings et al. (1966), it is necessary to integrate over the whole azimuth scan to average out departures from equilibrium and horizontal variations. When this is done, one obtains a ratio $\rho(5577)/\rho(4278)$ of slightly over 7.6. If the value 3.1 is used for the ratio $\rho(3914)/\rho(4278)$, this becomes $\rho(5577)/\rho(3914) \simeq 2.5$, which agrees within the limits of error with the previous observations. (W.D.M.)

10520 RADIAL DIFFUSION OF ELECTRONS AT LOW L VALUES. Farley, Thomas A. (Univ. of California, Los Angeles). J. Geophys. Res., 74: 377-80 (Jan. 1, 1969).

Kavanagh (1968) and Newkirk and Walt (1968) considered the diffusion equation as a first-order differential equation defining the diffusion coefficient in terms of the measured particle density, its time derivative, and an assumed pitch-angle scattering lifetime. This letter emphasizes the presence of the arbitrary constant in the solution of this equation, discusses its physical meaning, and indicates how it may be evaluated by use of an appropriate boundary condition. (W.D.M.)

10521 LATITUDE DEPENDENCE OF 6300 A (O I) TWILIGHT AIRGLOW ENHANCEMENT. Bennett, Robert T. (Rice Univ., Houston, Tex.). J. Geophys. Res., 74: 381-3 (Jan. 1, 1969).

A study of the latitude dependence of the twilight 6300 Å (OI) airglow enhancement attributable to conjugate photoelectrons is reported. Such an enhancement accompanies a presunrise ionospheric heating caused by photoelectrons produced in the sunlit magnetic conjugate atmosphere. In this study the limits over which the intervening magnetospheric domain permits the photoelectrons to propagate from one hemisphere to the other were determined. A lower limit of $L \sim 1.1$ and an upper limit of $L \sim 3.2$ were found. (W.D.M.)

10522 CORRECTIONS TO TOTAL ELECTRON CONTENT DATA FOR CHANGES IN LAYER HEIGHT. Yuen, P. C.; Roelofs, T. H.; Young, D. M. L. (Univ. of Hawaii, Honolulu). J. Geophys. Res., 74: 384-7 (Jan. 1, 1969).

One of the methods currently being used to obtain total electron content data depends upon the accurate measurement of the total Faraday rotation of linearly polarized signals from geostationary satellites. The usual simplification used in the reduction of data is to assume that the ionosphere remains essentially constant in relative shape and height, and hence the value of the magnetic field can be set equal to a constant corresponding to the field at some point on the ray path. This paper considers the error introduced in

the total content by changes in ionospheric layer height, and shows that if corrections are included, some of the smaller variations in electron content are apparent rather than real. (W.D.M.)

10523 COMPARISON OF THE RESULTS OF SYNOPTIC WHISTLER RECORDING AT DURBAN DURING IGY AND IQSY. Clarence, N. D. (Univ. of Natal, Durban, S. Afr.). J. Geophys. Res., 74: 388-92 (Jan. 1, 1969).

Daily recordings of whistlers were made at Durban during the IGY and IQSY. Several significant differences between the two periods are apparent. These differences are discussed. (W.D.M.)

10524 ATMOSPHERIC IMPLICATIONS OF PREDISSOCIATION IN N_2. Hudson, Robert D.; Carter, Virginia L. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 74: 393-5 (Jan. 1, 1969).

The purpose of this letter is to report some initial results of high-resolution (0.038 A) photoelectric absorption studies on molecular nitrogen, which indicate that most of the N_2 absorption bands seen between 800 and 960 Å are predissociated. This predissociation could contribute significantly, through absorption of solar radiation in this wavelength interval, to the production of atomic nitrogen in the upper atmosphere. (W.D.M.)

10525 DETECTION OF ALPHA PARTICLES IN AURORAL PHENOMENA. Reasoner, David Lukens. Houston, Tex., Rice Univ., 1968. 153p.

Thesis.

A coordinated rocket-borne particle and ground-based photometric experiment has shown that the ratio of fluxes of 200 keV alpha particles and 100 keV protons was approximately 2% in an aurora on February 9, 1967. The ratio of fluxes is shown to be not inconsistent with the results of a photometric search for auroral helium emission, and to be within a factor of 3 of alpha–proton density ratio in the solar wind measured by the spacecrafts Vela 3 and Pioneer 7. The measured value of the auroral alpha–proton ratio is shown to be 2 orders of magnitude greater than the value of He^{++}/H^{+} in the thermal ion densities in the magnetosphere out to 20,000 kilometers, and therefore it is concluded that these energetic auroral protons and alphas were once constituents of the solar wind, and furthermore that the auroral acceleration mechanism is at an altitude above 20,000 kilometers. The rocket-borne measurements of protons with energies above a few hundred eV were also used to predict Hβ optical intensities under the rocket. The calculated intensities ranged between 105 to 35 Rayleighs, in good agreement with the photometrically measured value of 46 Rayleighs. The present work is compared with the results of simultaneous proton flux and hydrogen emission measurements of other investigators. Rocket-borne electron and proton measurements were used to demonstrate the merging of zones of electron and proton precipitation over approximately 2.5° of latitude in the post substorm aurora, and this is compared with the distinct separation of the precipitation zones existing for a considerable period prior to the onset of the auroral substorm. Theoretical implications of the various experimental results are discussed, in particular the implications of the alpha-particle measurement to various theories of the auroral particle injection and acceleration processes. (Disser. Abstr.)

10526 DETERMINATION OF RATES OF PRODUCTION AND LOSS OF ELECTRONS IN THE F REGION OF THE IONOSPHERE FROM OBSERVATIONS OF GEOSTATIONARY SATELLITE TRANSMISSIONS. Smith III, Fred Lewis. Stanford, Calif., Stanford Univ., 1968. 134p.

Thesis.

Accurate measurements of the amount of Faraday rotation imposed on vhf telemetry transmissions from a geostationary satellite have been analyzed to study rates of production and loss of electrons in the F region of the ionosphere. The integrated rate of production of atomic oxygen ions at sunrise over Hawaii averaged 1.7×10^{9} ions/cm^2/s. The average is believed to be accurate to within ±15%. Day to day values fluctuated about a 30 day running mean with a standard deviation of ±15%. No seasonal variation was observed. The linear loss coefficient at sunrise over Hawaii was found to average 1.4×10^{-5} s^{-1} at an altitude of 300 km, with winter values tending to be about 50% above average and summer values about 50% below average. The average value should be accurate to within a factor of 2. The total flux of solar radiation in the 165 to 911 Å wavelength range incident on the atmosphere was found to average 4.5×10^{10} photons/cm^2/s. The average should be accurate to within ±30%. (TSS) (Disser. Abstr.)

10527 CONFIGURATION OF GEOMAGNETIC FIELD LINES ABOVE THE AURORAL ZONES. Schield, Milo Arvid. Houston, Tex., Rice Univ., 1968. 217p.

Thesis.

The plasma sheet extending into the Earth's magnetic tail has been observed by Vasyliunas and Freeman et al., to have a sharp inner edge. The inner edge of this plasma sheet appears to be coincident with magnetic field lines that map onto the auroral zones. These conclusions are drawn from a geomagnetic configuration based upon a self-consistent solution of the geomagnetic field with an internal quiet-day ring current field to which a realistic tail field has been joined. This model predicts that the auroral zone field lines do not map onto either the neutral sheet or the surface of the magnetosphere but are buried deep within the magnetosphere. This self-consistent calculation of the configuration of the geomagnetic field indicates the quiet-day ring current is unable to lower the surface latitude of the neutral point field line to auroral zone latitudes as had been suggested by Dessler and Juday. It has been proposed that an Alfvén layer will form in the magnetosphere. The Alfvén layer is the region of net charge on the boundary of the forbidden region that tends to develop when the tail plasma is convected into the Earth's dipole field. It is argued that the Alfvén layer accounts for the location and magnitude of the field-aligned currents (that produce the transverse magnetic disturbances observed by satellites at auroral latitudes), as well as the location and energy dependence of the inner edge of the plasma sheet. The thickness of the Alfvén layer is shown to correspond to the width of the zone of transverse magnetic disturbances. The field-aligned current necessary to neutralize the Alfvén layer is calculated to be about 10^6 amps which is sufficient to produce transverse magnetic disturbances of about 100γ. The location of the Alfvén layer is shown to be consistent with the size of the forbidden region for a convection field of 1 to 2 kV/R_E. The energy dependence of particles through the Alfvén layer is found to be caused by the thermal particles which carry a portion of the field-aligned neutralization current. The low energy cutoff in the auroral flux spectrum observed by Westerlund is explained as the result of Coulomb collisions with the ionosphere. The capability to explain the magnitude and location of the transverse magnetic disturbances provides strong evidence that the inner edge of the plasma sheet does map onto the auroral zone as predicted by this model of the magnetosphere. (Disser. Abstr.)

10528 HIGH-LATITUDE SATELLITE OBSERVATIONS OF ELECTRONS AND PROTONS AT 4000 KM. Burch, James Leo. Houston, Tex., Rice Univ., 1968. 201p.

Thesis.

High-latitude charged particle measurements in the energy range 50 eV $\lesssim E \lesssim$ 100 keV were made aboard the polar orbiting satellite Aurora 1 at 4000 km altitude. The principal results of this experiment are given. (TSS) (Disser. Abstr.)

10529 ROCKET-BORNE OBSERVATIONS OF THE AURORAL ELECTRON ENERGY SPECTRA AND THEIR PITCH-ANGLE DISTRIBUTION. Westerlund, Lawrence Hecker. Houston, Tex., Rice Univ., 1968. 150p.

Thesis.

The Javelin Twins I sounding rocket experiment was launched March 17, 1967, from Fort Churchill, Manitoba, into an IBC II aurora. A portion of the experiment was devoted to the measurement of the electron energy spectra as a function of pitch-angle. The electron differential energy spectra associated with the diffuse glow or mantle aurora can be characterized by a power law of the form $N(E) = N_0 E^{-(1.3 \pm 0.3)}$ between the energies of ~100 eV and ~25 keV. This characteristic spectrum, or continuum, reaches its peak flux near ≲100 eV, with a gradual shift of this peak to higher energies with time, latitude, and/or longitude. The precipitated electron energy spectra which produce the brighter auroral arcs are characterized by an intense peak in the vicinity of 6 keV. Contrary to other observations this spectrum is definitely not "monoenergetic." The total energy carried by the particles in this peak is nearly an order of magnitude more than the total energy in the continuum. Though the average or typical electron energy spectrum is relatively "hard" up to ~25 keV the power law slope changes abruptly from (-1.3 ± 0.3) to (-10 ± 1) above this energy. Thus the majority (>90%) of the energy influx is carried by electrons of less than ~25 keV. The pitch-angle distribution of the precipitated electrons is shown to be purely isotropic at all times during the flight for energies above ~1 keV. Below this energy the fluxes become peaked parallel to the magnetic field. The intensities of the backscattered electrons returning from below the payload are isotropic below 1 keV but become peaked perpendicular to the magnetic field above this energy. This distribution is in qualitative agreement with simple atmospheric Coulomb scattering theories and should provide excellent experimental tests for any detailed theoretical analysis which as yet remains to be performed for these lower energies (<20 keV). Varying degrees of inconsistencies have been found when the data are compared to magnetospheric models utilizing electrostatic fields, either perpendicular or parallel to the magnetic fields, as

a source of energization for auroral particles. However, the experimental results do seem to be most consistent with the magnetospheric models which allow the auroral zone field lines to penetrate into the geomagnetic tail region. (Disser. Abstr.)

10530 IONIZATION INCREASES ASSOCIATED WITH THE SMALL SOLAR PROTON EVENTS OF 5 FEBRUARY 1965 AND 16 JULY 1966. Hewitt, L. W. (Defence Research Telecommunications Establishment, Ottawa). Can. J. Phys., 47: 131-4(Jan. 15, 1969).

Observations of partial reflections from the ionosphere at vertical incidence at 2.66 MHz have been made at Resolute Bay, geographic latitude 74.7°N, since September 1963. By measuring the amplitudes of the ordinary and extraordinary backscattered waves information is obtained about electron number densities in the lower ionosphere. The results presented in this paper show that the partial reflection technique is more sensitive than most other ground-based experiments for the detection of D-region ionization increases associated with small solar proton events. Results obtained by the partial reflection experiment during the events of 5 February 1965 and 16 July 1966 are presented and compared with vlf and satellite observations. (auth) (Canada)

10531 SPECTRUM OF THE NIGHT AIRGLOW BETWEEN 3 AND 4 MICRONS. MacDonald, R.; Buijs, H. L.; Gush, H. P. (Univ. of Toronto). Can. J. Phys., 46: 2575-8(Dec. 1, 1968).

The spectrum of the night airglow has been measured between 3 and 4 μ at a limit of resolution of 4 cm^{-1}, the observations being made at an altitude of 95,000 feet. The most prominent feature of the spectrum is the $\Delta v = 1$ sequence of hydroxyl bands. An intensity analysis of the rotational structure yields a rotational temperature of 234°K. In addition, the ν_3 band of methane near 3000 cm^{-1} and the ν_3 band of CO_2 near 2350 cm^{-1} appear in emission. (auth)

10532 RELATIONS BETWEEN COSMIC-RAY FLUCTUATIONS AND THE STATE OF THE LOWER IONOSPHERE. Velinov, P. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci., 21: 115-18(1968). (In Bulgarian).

An equation for the mean value of the cosmic-ray-induced electron production rate in the cosmic layer of the lower ionosphere is derived. A form of the equation is given for low- and mid-latitudes, where the atmospheric absorption of cosmic rays is negligible. The equation is applied to the quantitative interpretation of the relation between the cosmic-ray variations and the cosmic layer of the lower ionosphere. Proceeding from the equation for relativistic cosmic rays, the rigidity spectrum of the 11-yr cosmic-ray variations and the equation for the rigidity spectrum of the 11-yr variations of the electron production rate are obtained. The influence of Forbush decreases on the degree of ionization of the lower portion of the D region is analyzed, and the various spectra of the Forbush decreases are examined. The influence of relativistic solar cosmic rays on the cosmic layer was determined, the results being obtained for a specific event characterized by the penetration of protons only and the absence of a magnetic storm. (ATD)

10533 D-REGION DYNAMICS DURING THE SOLAR ECLIPSE OF MAY 20, 1966. Nestorov, Georgi. Izv. Geofiz. Inst., Bulg. Akad. Nauk., 11: 23-33(1967). (In Bulgarian).

The total electromagnetic field strength on 182 kHz observed along the Ankara–Sofia test path during the solar eclipse of May 20, 1966, was subject to considerable variations. Occultation by the Moon of the solar disk was 99% complete in the reflection region. It is shown that immediately subsequent to initial contact, reflectance increased, attaining its peak value shortly after totality. Meanwhile, the lower boundary of the D region gradually ascended, with the general elevation at maximum phase being 6.15 km above the level of the quiet daytime ionosphere. As a consequence, during the totality of the eclipse the D region undergoes a significant compression, resulting in considerable reduction of short- and medium-wave absorption. Findings show that at the moment of totality, the condition of the D region corresponds to its condition during the solar ascent–descent period, but not to the nocturnal period as well. An analysis was made of the causes of this phenomenon in D region behavior, which was discovered to be primarily due to ionospheric relaxation (low recombination factor), the corona effect, ambipolar diffusion, and the diffusion of light within the Earth's atmosphere. Complete quantitative test data have been obtained regarding the speed of the movement and the height of the discrete ionization levels required for reflection of the observed signal. In view of the high speeds noted near the totality (1.8 $m \cdot sec^{-1}$), the D region cannot be regarded as a medium in a state of quasi-equilibrium. A complete analogy is established between the ionospheric effects of solar chromosphere bursts and those of the eclipse with respect to the movement of the lower ionosphere. A number of considerations are advanced having to do with the long-wave recording of absorption by the A3 method, using a loop antenna positioned perpendicularly to the direction of radio-wave propagation. (ATD)

10534 ASYMMETRY IN THE DIURNAL CHANGES OF THE ELECTRONIC CONCENTRATION IN THE IONOSPHERE. Samardzhiev, Dimitri; Serafimov, Kiril. Izv. Geofiz. Inst., Bulg. Akad. Nauk., 11: 63-86(1967). (In Bulgarian).

A parameter of asymmetry in the diurnal changes of electron concentration in the ionosphere is defined. The parameter adopted is the ratio of the respective electron concentration before and after the culmination of the Sun for equal zenithal angles, for equal $\cos\chi$ respectively. On the basis of the full form of the balance equation, this ratio was investigated by its determinant quantities in the following basic cases: α-ionospheric layer; β-ionospheric layer; asymmetry in the near-maximum parts of the α and β layers; and asymmetry in the ionospheric absorption. Analyses were made of probable sources of asymmetry, namely: solar ionizing radiation, equivalent recombination coefficient, temperature, average mass of the ionizable components, the exponent in the cosine dependence of electron concentration, etc. General and simplified expressions were worked out for the asymmetry coefficient η under different conditions. According to data from four medium-width ionospheres, two of which (Moscow and Durb) for the 1957–1965 period, the coefficients of asymmetry were calculated for the ionospheric parts with α deionization—layer E, the near-maximum part of the layer F1, and the laminar formations in the intermediate E–F region. The results obtained show that the morning values of the electron density and its corresponding frequencies are higher than the afternoon (i.e. $\eta > 1$). As for the F1 layer, there is a gradual decline of η for certain stations with the decline in the solar activity. An evaluation was made for η in the β ionospheric layer after data for N(z)-profiles (obtained from the Ahmedabad Station). The results obtained indicate that $\eta > 1$. Analogous values for η are obtained for the D region as well. The ratio between the afternoon and the morning values of the neutralization coefficient was calculated from the values of η under particular conditions. A similar analysis of the E layer gives values between 1.15 and 1.90 for this ratio, and the D region—about 2.19. Certain problems of the precision of the analysis are discussed, as well as the possibilities of using η to describe certain aeronomic quantities. (ATD)

10535 DIFFUSION OF SMALL INHOMOGENEITIES IN THE IONOSPHERE. Fiala, Vladimir (Geophysical Inst., Prague). Stud. Geophys. Geod., 12: 199-205(1968). (In Czech).

A system of equations was analyzed describing the diffusion of weak inhomogeneities in plasma. The effects of a potential disturbance of an electric field on diffusion processes in drifting plasma in a magnetic field are described. It is shown that a potential approximation for ambipolar diffusion in the ionosphere is satisfactory. The ambipolar diffusion takes place at a much slower rate than other diffusion processes and is therefore decisive for the decrease in electron density in the inhomogeneity. It was also shown that the effect of the nonpotential field, considering parameters corresponding to the ionosphere, is negligible for ambipolar diffusion itself. (ATD)

10536 PLASMA FLOW AROUND A TWO-DIMENSIONAL MAGNETIC DIPOLE. Managadze, G. G.; Podgornyi, I. M.; Rusanov, V. D. Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 432-4(1968).

Translated from Geomagn. Aeron., 8: 545-8(1968).

The interaction between a supersonic plasma flow with the magnetic field of a dipole is investigated. The results of measurements are in agreement with the assumption of the formation of a collision-free shock wave. (auth)

10537 THE PARTICLE AND FIELD ENVIRONMENT OF THE EARTH. Roederer, Juan G. (Univ. of Denver). Astronaut. Aeronaut., 7: No. 1, 22-8(Jan. 1969).

An attempt is made to give a comprehensive picture of the present knowledge of the particle and field environment of the Earth. The properties of the solar wind are reviewed and the bow shock, magnetosheath, and magnetopause are described. The field configuration and particle population of the magnetosphere are discussed. (W.D.M.)

10538 VLF PROPAGATION IN EARTH-IONOSPHERE WAVEGUIDE. Rybachek, S. T. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 393-8(1968).

Translated from Geomagn. Aeron., 8: 493-500(1968).

Numerical methods were used to solve the problem of the propagation of vlf electromagnetic waves in a spherical waveguide formed by an isotropic, radially inhomogeneous ionosphere and by the Earth, characterized by a reduced surface impedance. Characteristic dependences of phase velocity and of the attenuation of the waveguide modes on frequency of propagation during the daytime and at night are presented. The effect of the assignment of boundary conditions at the ionosphere on the eigenvalues of the problem is discussed. (auth)

10539 STUDY OF THE SPATIAL CHARACTERISTICS OF TYPE Pc5 GEOMAGNETIC PULSATIONS. Obertz, P.; Raspopov, O. M. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 424-7(1968).

Translated from Geomagn. Aeron., 8: 534-9(1968).

The behavior of geomagnetic pulsations of the Pc5 type was examined. It is shown that the region of Pc5 excitation is localized in space. Its longitudinal extent averages 60°. The period of pulsations in each individual case of their generation remains unchanged in the entire region of excitation and depends on the geomagnetic latitude at which Pc5 reaches a maximum amplitude. The character of the polarization of pulsations along a meridional profile was also investigated. (auth)

10540 INTERPRETATION OF Pc3,4 GEOMAGNETIC PULSATIONS. Bryunelli, B. E.; Lyatskaya, A. M.; Lyatskii, V. B. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 428-31(1968).

Translated from Geomagn. Aeron., 8: 540-4(1968).

Possible Alfvén resonances in segments of magnetic force tubes bounded by the region of a weak field in the vicinity of neutral points at the magnetosphere boundary on the one side and by the surface of the Earth on the other are discussed. It is shown that the excitation of resonance in the fundamental harmonic is more likely in force tubes nearest to the neutral points, while resonances in the second harmonic can be more effective in deeper layers of the magnetosphere. Resonance in the fundamental harmonic is identified with geomagnetic Pc4 pulsations and in the second harmonic with Pc3 pulsations. (auth)

10541 DEVICE FOR INVESTIGATING FREQUENCY CORRELATION. Afraymovich, E. L. (Ionospheric Section, Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 445-7(1968).

Translated from Geomagn. Aeron., 8: 560-2(1968).

A multichannel, high-frequency-resolution spectral analyzer of pulses reflected from the ionosphere is described. The analyzer can also be used to investigate the dependence of the cross-correlation coefficient on frequency separation. The recording and processing of the data are completely automated. The first results of the operation of the device are reported. (auth)

10542 ROLE OF NONADIABATIC PARTICLE LOSSES IN THE INNER RADIATION BELT. Il'in, V. D. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 449-51 (1968).

Translated from Geomagn. Aeron., 8: 564-6(1968).

It is shown that nonadiabatic losses have no effect on the magnitude of the integral flux ($E_p \geq 40$ MeV) in the inner belt, but affect the upper part of the energy spectrum of protons. As L increases, the lifetime drops sharply and, therefore, the main nonadiabatic losses will occur at great distances from the Earth. (W.D.M.)

10543 RADIAL DIFFUSION OF ELECTRONS OF ENERGY GREATER THAN 100 keV IN THE OUTER RADIATION BELT. Vernov, S. N.; Kuznetsov, S. N.; Logachev, Yu. I.; Lopatina, G. B.; Sosnovets, E. N.; Stolpovskii, V. G. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 323-30(1968).

Translated from Geomagn. Aeron., 8: 401-11(1968).

The 1964 studies of the time variations of electrons of energy $E_e > 100$ keV in the outer radiation zone show that the variations in electron intensity on drift shells close to the Earth lag systematically behind electron variations on shells with high L values. This delay is due to the diffusion of electrons with $E_e > 100$ keV across the drift shells. The "delay" time, Δt, between electron intensity variations on various L shells was determined statistically and was found to be $\sim 5 \pm 1$ day for $L = 5.0$ and $L = 4.0$. Under certain assumptions, this leads to a drift velocity of $\bar{v} \sim 0.2\ R_E$ per day for $L \sim 4.4$. The time and velocity of electron drift in the interval $4.0 < L < 5.0$, measured from direct observation of the systematic shift of the leading edge of the "wave" of electrons with $E_e > 100$ keV and >400 keV, agree within the limits of errors with the results obtained by the correlation method. The rate of electron diffusion is independent of geomagnetic latitude. (auth)

10544 CYCLOTRON INSTABILITY OF OUTER RADIATION-BELT PROTONS. Gul'yel'mi, A. V. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 331-6(1968).

Translated from Geomagn. Aeron., 8: 412-19(1968).

The cyclotron instability of the belt of trapped protons was analyzed, taking into account data on the spatial distribution and ion composition of the exospheric plasma. It is shown that hydromagnetic emission from the proton belt can be identified with "pearl" type micropulsations of the geomagnetic field, but is apparently manifest in the form of continuous broadband emission in the range of ~0.5 Hz. The relationship between pulsations with a decreasing period and the ring current responsible for the main phase of magnetic storms is discussed. (auth)

10545 DYNAMICS OF WINDS IN THE IONOSPHERE. Khantadze, A. G. (Inst. of Geophysics, Tbilisi, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 337-41(1968).

Translated from Geomagn. Aeron., 8: 420-5(1968).

It is shown that curvilinear plasma motions in the ionosphere are of the same nature as cyclones and anticyclones in the troposphere. Various problems of unstable wind in the ionosphere are solved as a function of the form of the pressure gradients. Tidal winds are analyzed with allowance for electromagnetic factors and estimates are given of the stability of winds for various ionospheric layers. (auth)

10546 SYNOPTIC OBSERVATIONS OF THE F2 LAYER OF THE IONOSPHERE IN THE MAGNETICALLY CONJUGATE REGIONS KERGUELEN–ARKHANGEL'SK PROVINCE. Ben'kova, N. P.; Bukin, G. V.; Davoust, K.; Kerblay, T. S.; Taieb, C. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 342-5(1968).

Translated from Geomagn. Aeron., 8: 426-31(1968).

The results of ionospheric observations in magnetically conjugate regions were analyzed. Two types of relationships were found in comparing the f_0F2 deviations from the median values ($\Delta f_0 f2$) for pairs of stations located in conjugate regions: (1) in-phase variations observed during magnetic–ionospheric disturbances and (2) anti-phase variations for a weak magnetic field. There is no correlation in magnetically quiet periods. (auth)

10547 RECEPTION CONDITIONS OF WWV SIGNALS AT NEUSTRELITZ AS A FUNCTION OF SOLAR ACTIVITY. Zhulina, E. M.; Lange, G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow. Heinrich Hertz Inst., Berlin). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 399-402(1968).

Translated from Geomagn. Aeron., 8: 501-7(1968).

The results of measurements of the field intensity of a WWV signal in the period 1954–1958 were analyzed. It was found that the signal field intensity at frequencies 10 and 15 MHz decreases toward years of minimum solar activity. The role of deviative absorption in this phenomenon is pointed out. This effect is absent at 5 MHz. Theoretical estimates of field intensity are given and the results of a comparison of predicted and measured values in various years are described. (auth)

10548 DETERMINATION OF THE VERTICAL OZONE DISTRIBUTION IN THE UPPER LAYERS OF THE ATMOSPHERE FROM SATELLITE MEASUREMENTS OF ULTRAVIOLET SOLAR RADIATION SCATTERED BY THE EARTH'S ATMOSPHERE. Iozenas, V. A. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 403-7(1968).

Translated from Geomagn. Aeron., 8: 508-13(1968).

A method of solving the integral Laplace equation by approximating the experimental function by linear-fractional functions to determine the vertical ozone distribution is described. The results of computations for a given vertical ozone concentration distribution are presented. (auth)

10549 STATIONARY REGIME OF ATMOSPHERIC OZONE ABOVE KRASNAYA PAKHRA. Steblova, R. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 408-13 (1968).

Translated from Geomagn. Aeron., 8: 514-20(1968).

It is demonstrated that the daytime variations in effective ozone temperature differ substantially from the nighttime variations, whereas variations in total ozone content are of the same nature. The annual pattern of the total ozone content has a minimum between the spring and the secondary summer maxima.

The diurnal pattern of effective temperature forms a symmetrical oval curve with a steep decline at sunrise and sunset. The effective temperature increases by ~10°C at local midnight. The noon values of effective temperature reach a minimum in the annual pattern during the summer solstice at which time the night values reach a maximum. (auth)

10550 INFLUENCE OF GLOBAL ANOMALIES ON Sq VARIATIONS. Dodon, G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 414-19(1968).

Translated from Geomagn. Aeron., 8: 521-8(1968).

The latitudinal and longitudinal patterns of the parameters of S_q variations are constructed from the data of the global network of magnetic observatories for 1964. It is shown that the longitudinal pattern of S_q variations is associated with the influence of global magnetic anomalies. The influence of global anomalies is more distinct on the II harmonics of the X and Z components of the S_q field. (auth)

10551 RELATIONSHIP BETWEEN MIDDLE-LATITUDE VLF EMISSIONS AND MAGNETIC ACTIVITY. Keymenova, N. G.; Troitskaya, V. A.; Vigneron, J. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 420-3(1968).

Translated from Geomagn. Aeron., 8: 529-33(1968).

The dependence on magnetic activity of the properties of vlf emissions observed at magnetically conjugate points was investigated. It is shown that study of this relationship can serve as an indirect method for investigating processes in the outer radiation belt. (auth)

10552 DIRECTIONAL HYDROMAGNETIC EMISSION AND CURRENTS ALONG GEOMAGNETIC LINES OF FORCE. Van'yan, L. L.; Gokhberg, M. G. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 452(1968).

Translated from Geomagn. Aeron., 8: 567(1968).

It is shown that directional hydromagnetic emission does not decrease along the z axis, is maximal on lines of force crossing the source, and decreases rapidly with distance from them. (W.D.M.)

10553 RADIATION BURSTS IN THE SUBPOLAR STRATOSPHERE. Novikov, A. M.; Shafer, Yu. G. (Inst. of Cosmophysical Investigations and Aeronomy, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 454-6(1968).

Translated from Geomagn. Aeron., 8: 569-70(1968).

The beginning, development, and termination of radiation intensity bursts were recorded over Tixie at atmospheric depths less than 50 g/cm² on May 19 and Dec. 14, 1966 and March 29, 1967, by single STS-6 gas-discharge counters lifted into the stratosphere by balloon sondes. Results of these measurements are shown. (W.D.M.)

10554 ANALYTIC DESCRIPTION OF THE PLANETARY DISTRIBUTION OF IONOSPHERIC PARAMETERS. Bazarzhapov, A. D.; Chernyshev, O. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 456-8(1968).

Translated from Geomagn. Aeron., 8: 571-3(1968).

Spherical harmonic analysis is used to describe the planetary distribution of ionospheric parameters. The investigations were based on monthly median f_0F2 values at 124 stations in April 1959. A method is given for computing the characteristics of the planetary distribution of f_0F2 in sufficient detail. (W.D.M.)

10555 SELECTION OF THE OPTIMUM LENGTH OF A SERIES APPROXIMATING DIURNAL f_0F2 VARIATIONS ON A PLANETARY SCALE. Chernyshev, O. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 459-61(1968).

Translated from Geomagn. Aeron., 8: 574-6(1968).

Series approximating some variation of a parameter are normally used in the analytic description of the space–time variations of f_0F2. This article is concerned with the selection of the optimum length of a Fourier time series, approximating the diurnal variation of $f_0F2(t)$ on a planetary scale. The investigation was based on the monthly median f_0F2 values at 132 vertical sounding stations in April 1958. (W.D.M.)

10556 WINDS AT HEIGHTS OF 150 TO 400 KM IN THE ATMOSPHERE. Anan'eva, N. M.; Klimov, N. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 461-3 (1968).

Translated from Geomagn. Aeron., 8: 577-8(1968).

The wind velocity field was computed for 22 stations in the Northern and Southern Hemispheres for March and Dec. 1958 at 12 hr UT in the height interval 150 to 400 km. Jacchia's model was used in the computations. The parameters for the intermediate temperature values were found by linear interpolation. It is shown that wind velocity increases with height and varies by ~100 msec^{-1} at 300 to 400 km. (W.D.M.)

10557 BEHAVIOR OF CRITICAL E-REGION FREQUENCIES AT LARGE SOLAR ZENITH ANGLES Korsunova, L. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 464-6(1968).

Translated from Geomagn. Aeron., 8: 579-81(1968).

The variations in critical E-layer frequencies were studied at large zenith distances of the Sun ($Z_\odot > 70°$). The results of ionospheric measurements at three stations (Tomsk, Moscow, and Irkutsk) were analyzed. The results of daily ionospheric observations according to a 15-min program from May 1963 through April 1964 were used. Days with a quiet magnetic field (not less than 10 per month) were selected when the 3-hour values of the K indices were ≤ 3 and $\Sigma K \leq 20$. (W.D.M.)

10558 SPATIAL DISTRIBUTION OF THE VERTICAL MOVEMENTS OF IONIZED FORMATIONS IN THE IONOSPHERE. Vasil'ev, K. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 466-8(1968).

Translated from Geomagn. Aeron., 8: 582-4(1968).

It is concluded that vertically moving ionized formations in the ionosphere do not have a wide front (1000 km or more), but have relatively limited dimensions (~100 km). Regions with these ionized formations are frequently encountered at intervals of ~60 to 200 km. These results agree with the conclusions derived by Vinogradova, et. al. (1968). It is noted that in the cases in question, the vertical movements of ionized formations in the F1 layer are hardly associated with internal gravity waves. (W.D.M.)

10559 DETERMINATION OF THE PARAMETERS OF THIN SPORADIC LAYERS OF THE E-REGION OF THE IONOSPHERE. Pivovarova, N. B.; Timoshenko, L. F. (Inst. of Cosmophysical Investigations and Aeronomy, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 470-1(1968).

Translated from Geomagn. Aeron., 8: 587-8(1968).

Study of sporadic formations in the E region is closely associated with the quantitative determination of some quantities characterizing the dynamics of their formation and development. These quantities include: the half-thickness of the layer, a; the height of the ionization maximum, H_{max}; maximum electron concentration, N^e_{max}; and the collision frequency of electrons with neutral atoms. A description is given here of one of the methods of determining the above quantities by pulse recording of the amplitudes of a reflected signal and from the standard ionogram of the AIS ionosonde. The study is based on computations on an electronic computer of the reflection coefficient of an electromagnetic wave from the thin layer of a partly ionized gas with allowance for absorption in it. (auth) (TSS)

10560 EFFECTIVE VELOCITY OF VERTICAL DISPLACEMENTS OF THE LOWER IONOSPHERE AT SUNSET AND SUNRISE. Vilenskii, I. M.; Smirnova, A. V.; Endikov, G. I. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 472-3(1968).

Translated from Geomagn. Aeron., 8: 589-90(1968).

The possibility was discussed by Vilenskii and Podlipalin (1964) of studying the vertical displacement rate of the lower ionosphere by spectral analysis of records of the field intensity of long-wave radio stations at sunrise and sunset and during a solar eclipse. It is assumed that, owing to the vertical displacement of the region of radio-wave reflection, there appears a periodic (in the first approximation) time dependence of the signal amplitude at the reception point. Records on the field intensity of long-wave radio stations on short links were obtained in 1965 and subjected to spectral analysis. The field intensity was recorded simultaneously at frequencies of 394 and 272 kHz. (W.D.M.)

10561 PRELIMINARY ANALYSIS OF MICROPULSATIONS OF THE ELECTROMAGNETIC FIELD OF THE EARTH ASSOCIATED WITH THE PROTON FLARE OF JULY 7, 1966. Matveeva, E. T.; Troitskaya, V. A. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 480-2 (1968).

Translated from Geomagn. Aeron., 8: 598-600(1968).

The character of micropulsations prior to and after the proton flare observed at 00h 25 m UT on July 7 in the northeast quadrant of the solar disc ($\varphi = +30°$, $\lambda = +35°$) was investigated on the basis

of data from 12 observatories located in the polar caps, the auroral zones, and at middle latitudes. The analysis was performed for the first half of July from records taken at low and high speed separately. (W.D.M.)

10562 SPATIAL STRUCTURE OF THE RESIDUAL Z_{ae} FIELD. Pudovkin, I. M.; Kolesova, V. I.; Valueva, G. E. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 483-6 (1968).

Translated from Geomagn. Aeron., 8: 601-2(1968).

The upward extrapolation of the vertical component, Z, of the 1955 epoch, to various heights makes it possible to determine the parameters of the eccentric dipole by a method other than that of Schmidt. The Z_e field (field of the eccentric dipole) was computed over the entire sphere. The Ze field was taken to be normal to separate the anomalous field Z_{ae}, which is presented. The geographic coordinates of the major anomalies and the Z_{ae} values in them are given. (W.D.M.)

10563 ESTIMATES OF THE LOSS COEFFICIENTS AND OF THE RATES OF ION–MOLECULE REACTIONS IN THE NIGHT-TIME F REGION OF THE IONOSPHERE FROM $n_e(h,t)$ PROFILES AT MOSCOW. Fatkullin, M. N.; Legen'ka, A. D. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 346-52(1968).

Translated from Geomagn. Aeron., 8: 432-40(1968).

The theoretical bases for estimates of the loss coefficient β in the ionosphere from $n_e(h,t)$ profiles are discussed. The loss coefficient is computed with and without allowance for transport of electrons in the nighttime F region. The coefficients of the rates of ion–molecule reactions of O^+ with O_2 and N_2 are estimated from the computed β values and definite models of the neutral atmosphere. The vertical transport velocities of electrons are also estimated. (auth)

10564 IONIZATION INDEX, ELECTRON FORMATION, AND EFFECTIVE RECOMBINATION COEFFICIENT IN THE E2 LAYER. Serafimov, K.; Kasymova, A. (Geophysical Inst., Sofia. Geo-Physical Inst., Kiev). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 353-7(1968).

Translated from Geomagn. Aeron., 8: 441-7(1968).

The ionization index, J_{E2}, is determined with allowance for the influence of the rate of change of electron concentration, N_mE2, dynamic processes, and significant fluctuations of N_mE2. A method of determining J_{E2} is proposed which takes into account the critical frequencies, f_0E2, during the daytime. The values obtained without allowance for the seasonal effect correlate with the average sunspot number. Values of $5 \cdot 10^{-9} \leq \alpha_{eff}E2 \leq \alpha_{eff}E \approx (6\text{-}10) \cdot 10^{-9}$ cm^3 sec^{-1} are obtained for the effective recombination coefficient, $\alpha_{eff}E2$, and $\alpha_{eff}E2 \approx (5 \cdot 10^{-9} - 10^{-8})$ cm^3 sec^{-1} during sunrise–sunset. Expressions are derived for electron formation, q_0E2, as a function of solar activity. The smaller influence of solar activity on the J_{E2} index and on electron concentration, N_mE2, adequately explains the seasonal pattern in the case of appearance of the E2 layer. (auth)

10565 IONIZATION OF THE LOWER IONOSPHERE BY COSMIC RAYS. Velinov, P. (Geophysical Inst., Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 358-64(1968).

Translated from Geomagn. Aeron., 8: 448-56(1968).

The analytical problem is solved of computing the rate of electron formation in the lower ionosphere by interaction of cosmic rays with the atmosphere. The ionization of subrelativistic and relativistic solar and galactic cosmic rays is analyzed. Absorption in the atmosphere was taken into account in the ionization of low-energy particles. (auth)

10566 DESCRIPTION OF DRIFTS AND OF THE INHOMOGENEOUS STRUCTURE OF THE IONOSPHERE OVER ROSTOV-ON-THE-DON DURING THE IGY–IQSY PERIOD. Pozigun, V. L. (Rostov-on-the-Don State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 365-8(1968).

Translated from Geomagn. Aeron., 8: 457-61(1968).

Ionospheric drifts over Rostov-on-the-Don in the period from 1958 to 1966 were investigated. No significant difference was found between the speeds and directions of drifts over the solar activity cycle. It was found that the degree of "turbidity" of the E and E_s layers differs and has a diurnal pattern, which is probably associated with a change in reflection heights. (auth)

10567 RESULTS OF MEASUREMENTS OF COSMIC RADIO NOISE ABSORPTION IN THE IONOSPHERE WITHIN HALF OF A SOLAR ACTIVITY CYCLE. Belikovich, V. V.; Benediktov, E. A. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 369-75(1968).

Translated from Geomagn. Aeron., 8: 462-70(1968).

The results of measurements of cosmic radio noise absorption in the ionosphere from 1959 to 1965 are reported. The observations were made in the vicinity of the city of Gor'ki at several fixed frequencies in the range 9 to 25 MHz. (auth)

10568 SEASONAL VARIATIONS IN THE POSITION OF THE AURORAL ABSORPTION ZONE. Zhulina, E. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 376-9 (1968).

Translated from Geomagn. Aeron., 8: 471-5(1968).

The latitudinal distribution of the frequency of anomalous absorption in summer and winter is constructed for specific magnetically active periods at 0 and 12 LT from the results of ionospheric observations of f_{min} from 1962 to 1963 at the network of high-latitude stations. The auroral absorption zone is located at the same latitude at midnight in summer and winter. The afternoon position of this zone changes with the seasons and is located at higher latitudes than at midnight, particularly in summer. The auroral absorption zone shifts toward the equator in summer and winter as magnetic activity increases and this shift is greater on the day than on the night side. The results obtained are interpreted as a consequence of the asymmetric shape of the magnetosphere. (auth)

10569 METHOD OF FINDING THE ELECTRON CONCENTRATION PROFILE IN THE D LAYER OF THE IONOSPHERE FROM THE FREQUENCY DEPENDENCE OF RADIO WAVE ABSORPTION. Belikovich, V. V.; Itkina, M. A. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 380-4(1968).

Translated from Geomagn. Aeron., 8: 476-82(1968).

A method of solving an integral equation for determining the N(h) profile in the D layer of the ionosphere from the frequency dependence of absorption, $\Gamma(\omega)$, is described. This method reduces the influence of random errors in the function $\Gamma(\omega)$. The method in question is used to compute the N(h) profiles from the results of measurements of polar-type anomalous absorption in the frequency range 9 to 40 MHz. (auth)

10570 RELATION OF VERTICALLY MOVING IONIZED FORMATIONS TO SOLAR AND MAGNETIC ACTIVITY. Vasil'ev, K. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 385-7(1968).

Translated from Geomagn. Aeron., 8: 483-5(1968).

The relationship between vertically moving ionized formations and solar activity was examined. An inverse relationship was found between the probability of movements and magnetic activity. It is shown that the average number of vertical movements recurs every 27 days. The number of cases of stratifications increases with solar activity to a certain limit after which it decreases with a further increase in solar activity. (auth)

10571 BURSTS OF VLF RADIATION. Likhter, Ya. I.; Molchanov, O. A.; Sobolev, Ya. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 388-92(1968).

Translated from Geomagn. Aeron., 8: 486-92(1968).

Bursts of vlf radiation, recorded during an expedition along the Northern Dvina River in July–October 1966, are analyzed. It is found that the probability of detecting bursts increases monotonically with increasing magnetic activity. (auth)

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Refer also to abstracts 10869 and 10870.

10572 (DEMO-68/6) A SIMPLE CRYOSTAT FOR N.Q.R. MEASUREMENTS. Milia, Fanny K. (Democritus Nuclear Research Center, Athens (Greece)). Aug. 1968. 8p. Dep.

A simple and inexpensive cryostat is described especially designed for NQR measurements in the range of 0 to –195°C. The system can be used for maintaining a constant temperature as well as for measurements where a slow variation of temperature is desired. The set temperature can be maintained over periods up to 3 days with a stability of 0.5%. (auth)

10573 (UCRL-18452) CRITICAL TEMPERATURE OF Nb_3Sn IN VARIOUS MICROSTRUCTURES. Goolsby, Roger (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1968. Contract W-7405-eng-48. 51p. Dep. CFSTI.

Thesis.

The effects of process variables on the microstructural distribu-

tion and critical temperature (T_c) of Nb_3Sn were studied. By utilizing two preparation techniques it was possible to prepare samples whose microstructures consisted of a Nb_3Sn film network surrounding a second phase of either niobium or NbC. The critical temperature of a sample with such a network was approximately the same as that for bulk Nb_3Sn. One preparation technique consisted of sintering niobium, tin, and carbon powders, while the other technique consisted of impregnating a porous niobium powder compact with liquid tin and reacting to form a Nb_3Sn film network at the niobium–tin interface. The critical temperatures of the samples were varied systematically by change of process variables, with T_c values ranging from 15.9 to 17.8°K. For samples prepared by the sintering process, a linear relationship was observed between upper critical field and critical temperature. Efforts were made to refine the microstructure by obtaining a very thin (<1000-Å) Nb_3Sn film network, because it was anticipated that thin film superconducting effects would result if sufficiently thin films were obtained. (auth)

10574 THE APPROACH TO EQUILIBRIUM IN A PURE SUPERCONDUCTOR. THE RELAXATION OF THE COPPER PAIR DENSITY. Schmid, Albert (Univ., Karlsruhe, Ger.). Phys. Kondens. Mater., 8: 129-40(Nov. 12, 1968).

Electron–phonon and electron–electron collisions are the processes which determine the relaxation time τ_R of the Cooper pair density. The case is considered for which the deviation of the pair density from equilibrium is small and where the equilibrium state is homogeneous. Starting from the Eliashberg equation, one is able to reduce the problem to a quadrature once the equilibrium Green functions are known. If the deviation is constant in space, and $T/T_c \gtrsim 0.5$, we find $\tau_R \approx \sqrt{T_c/(T_c-T)}\tau_c$, where τ_c is the collision time ($\approx 10^{-8}$ sec). For a deviation modulated in space, τ_R very quickly reaches the limiting value τ_c. (auth)

10575 ENERGY STATES AND TRANSITIONS IN A SUPERCONDUCTING LOOP CONTAINING A JOSEPHSON JUNCTION. Carter, John Tatum. Houston, Tex., Rice Univ., 1968. 71p. Thesis.

The energy states and transitions in a superconducting loop containing a Josephson junction have been studied, and transitions corresponding to the admission of approximately 10^4 flux quanta into the loop have been observed. The final states correspond to a decay of the current in the superconducting loop to about two-thirds of its initial value. Voltage pulses were recorded during the transition, and the decay times obtained from these pulses agree qualitatively with time constants calculated from elementary circuit theory. An attempt is made to describe the current through the junction while in the resistive state as due to oscillating pair and quasi-particle currents. The current decay in the loop would then be due to a decay of the average quasi-particle current, but the reason for the final nonzero current state is not understood. (Disser. Abstr.)

10576 SOME REMARKS ON THE HYDRODYNAMIC EQUATIONS WITH VISCOUS TERMS FOR THE BOSE SUPERFLUID. Galasiewicz, Z. (Univ., Wroclaw. Univ. of Copenhagen). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 16: 751-5(1968).

It is shown that kinetic coefficients B, B*, formally introduced into the hydrodynamical equations with sources of particles for the Bose superfluid, can be expressed in terms of the coefficient of the second viscosity. The superfluid is described by means of two thermodynamic parameters, for which one can choose the density of the numbers of particles and the temperature, and, moreover, by the components of the velocities of the superfluid and the normal component. (M.O.W.)

10577 CONNECTIONS BETWEEN TWO-LEGS AND THREE-LEGS GREEN'S FUNCTIONS FOR THE SUPERFLUID BOSE SYSTEMS. Galasiewicz, Z. (Univ., Wroclaw). Bull Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 16: 757-63(1968).

A Bose system that is in thermodynamic equilibrium when $t = -\infty$ is considered. A brief theoretical analysis relating the two-legs and three-legs Green functions for the system is given. (M.O.W.)

10578 SUPERCONDUCTIVITY MEASUREMENTS IN SOLDERS COMMONLY USED FOR LOW TEMPERATURE RESEARCH. Warren, W. H. Jr.; Bader, W. G. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Rev. Sci. Instrum., 40: 180-2(Jan. 1969).

Superconducting transition temperatures and critical field data are given for the more commonly used solders and for several low melting and special purpose solders. Additional information is supplied on the melting range, applicable flux, and usefulness in soldering particular metals. Several relatively low melting point solders not displaying superconductivity above 1.3 K are given. (M.O.W.)

10579 LOW-PASS SUPERCONDUCTING FILTER FOR USE IN HIGH MAGNETIC FIELDS. Goldstein, I. S.; Tobin, P. J. (Massachusetts Inst. of Tech., Cambridge). Contract SD-90. Rev. Sci. Instrum., 40: 172-3(Jan. 1969).

A superconducting filter having the following properties is briefly described: (1) an attenuation of roughly 10 at 6 Hz, and (2) effectiveness in fields up to 150 kG. (M.O.W.)

10580 SIMPLE, INEXPENSIVE LIQUID HELIUM TEMPERATURE CONTROLLER, USING INTEGRATED SEMICONDUCTOR CIRCUITS. Venegas, Carlos M.; Finegold, Leonard (Univ. of Colorado, Boulder). Rev. Sci. Instrum., 40: 159-62 (Jan. 1969).

We describe a controller for regulating the temperature of a pumped liquid-helium bath. The controller is a considerable improvement over previous controllers in that it is much simpler and less expensive. These improvements are due mainly to an uncommon direct-coupled alternating current circuit, and to extensive use of the recently introduced integrated semiconductor circuits. The controller operates by measuring the resistance of a carbon radio resistor immersed in the liquid helium bath, and then feeding back a proportional correction current to a heater. The controller will control a bath to within 100 μK over a period of 20 min, at 2.1 K, and could be used to control the temperature of a copper block over a wide range of temperatures. (auth)

10581 IMPROVEMENTS IN OR RELATING TO SUPERCONDUCTING COILS. Cornish, Donald Nelson; Whittle, Harry Reed (to United Kingdom Atomic Energy Authority). British Patent 1,138,213. Dec. 27, 1968. Filed May 25, 1966.

A superconducting coil may consist of a composite structure formed by a superconductor in intimate contact throughout its length with a normal conductor of high conductivity, this normal conductor acting as a shunt when a transient instability causes a portion of the superconductor to become normal. In the arrangement described the coil is immersed in cryogenic coolant and means are provided for pumping the cryogenic coolant through the coil in good thermal contact with the composite superconductor. The coolant may be liquid helium, either as helium-I, as helium-II, or as supercritical helium. (UK)

10582 ANALYTIC EXPRESSIONS FOR THE THERMODYNAMIC FUNCTIONS OF SUPERFLUID HELIUM. Singh, A. D. (Univ. of Waterloo, Ont.). Can. J. Phys., 46: 2607-18(Dec. 1, 1968).

Analytic expressions for the thermodynamic functions of superfluid helium are derived by using the experimental dispersion curve for the elementary excitations. The values of the various macroscopic properties calculated this way are in good agreement with those computed by Bendt et al. through numerical integration. This study brings out the relative importance of the various parts of the dispersion curve. The errors made while making the Landau approximations are also brought out. (auth)

10583 ELECTRICAL CONDUCTIVITY OF A TWO-DIMENSIONAL SUPERCONDUCTOR. Marcelja, S.; Masker, W. E.; Parks, R. D. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 22: 124-7(Jan. 27, 1969).

The results of detailed experimental study of the temperature dependence of the electrical conductivity of a two-dimensional superconductor in the transition region are discussed in terms of a model which treats the critical region as well as the classical regions above and below the superconducting transition temperature T_c. The data taken below T_c suggest a means of distinguishing the contribution to the broadening of the resistive transition due to sample inhomogeneity from that due to intrinsic fluctuations. (auth)

10584 INFLUENCE OF NORMAL d BAND ON SUPERCONDUCTING s BAND IN TWO-BAND SUPERCONDUCTORS WITH NONMAGNETIC IMPURITIES. Chow, W. S. (Univ. of Cincinnati). J. Phys., C (London), 2: 111-16(Jan. 1969).

A two-band superconductor model with one normal d band and one superconducting s band in the presence of nonmagnetic impurities is investigated. The nonmagnetic impurities cause interband as well as intraband scattering. The phase transition temperature of the superconducting s band is obtained in the limit of low impurity density, and is found to be lower than that of the corresponding pure two-band superconductor. (auth) (UK)

10585 SUPERCONDUCTIVITY IN ALKALI METALS. Schneider, T.; Stoll, E.; Buehrer, W. Helv. Phys. Acta, 42: 46-50(Feb. 15, 1969). (In German).

The contribution of the electron–phonon interaction to the

density of states and other parameters of the superconducting state are calculated using the pseudopotential approach. On the basis of these calculations, the occurrence of superconductivity in alkali metals is discussed. (auth)

10586 THE OSMOTIC PRESSURE OF DILUTE SOLUTIONS OF ^{3}He IN ^{4}He. Seiden, Joseph (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 267: 917-19(Oct. 28, 1968). (In French).

The theoretical expressions for the osmotic pressure Π for dilute solutions of ^{3}He in superfluid ^{4}He are given. The theoretical expressions are then compared with experimental results. The experimental results for $T \ll T_F$ are satisfactory, where T_F is the Fermi temperature of ^{3}He in the solution. Wilson et al. ((Phys. Rev. Lett., 19: 1368 (Dec. 11, 1967)) made measurements of Π for $T > 2T_F$, but their results can not be theoretically interpreted without assuming a repulsive potential U(r). The authors feel new measurements are necessary to precisely determine Π in this temperature area. (J.S.R.)

10587 UPPER CRITICAL FIELD OF TWO-BAND SUPERCONDUCTORS CONTAINING NONMAGNETIC IMPURITIES. Chow, W. S. (Univ. of Cincinnati). Phys. Rev., 176: 525-30 (Dec. 10, 1968).

By making use of a 4 × 4-matrix Green's function suitable for the two-band model of the superconducting phase of the transition metals, generalized 2 × 2-matrix Gor'kov equations are established. With these, Maki's theory of the upper critical field of one-band superconductors in the "dirty" limit is extended to the two-band model in the "dirty" limit and in the strong intraband phonon-coupling limit. It is found that in the temperature range between the d-band critical temperature and the s-band critical temperature, the upper critical field is uniformly decreased because of the interband impurity scattering. The general behavior of the upper critical field as a function of temperature is discussed. (auth)

10588 MOTION OF NORMAL REGIONS ALONG A SUPERCONDUCTING STRIP. Clem, John R. (Ames Lab., Iowa). Phys. Rev., 176: 531-7(Dec. 10, 1968).

The local temperature and heat current density in a superconducting strip whose ends are maintained at constant temperature are calculated for the case of periodically repeating motion of magnetic-flux-containing normal regions along the strip. The effective transport entropy per unit length per flux quantum, associated with the motion, is calculated; reasonable agreement with experiment is found. The power dissipation arising from the presence of temperature gradients is found to be small by comparison with the electrical dissipation in pure, but not in impure, superconductors. The presence of local thermal gradients is estimated to have an important influence upon the thermogalvanomagnetic effects in superconductors. (auth)

10589 MAGNETIC-FIELD DEPENDENCE OF RADIO-FREQUENCY FLUX PENETRATION IN TYPE-II SUPERCONDUCTORS. Carlson, D. E.; McLean, W. L. (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Rev., 176: 538-46(Dec. 10, 1968).

The magnetic-field dependence of the penetration of radio-frequency fields has been measured in type-II superconductors. Discussed is information obtained concerning the mixed state, the superconducting surface sheath, and superconducting cylindrical thin films. Some of the results, such as structure near H_{c2}, are interpreted in terms of vortex motion and effects of the sheath. Results pertaining to the sheath are compared with the calculations of Fink and Kessinger and of Maki. Other results in the mixed state are related to surface impedance calculations of Maki and of Caroli and Maki, based on the microscopic theory. Penetration depth measurements in the films agree better with a naive model than with Pincus's theory. (auth)

10590 ANOMALOUS THERMAL CONDUCTIVITY OF SUPERCONDUCTORS DUE TO IMPURITY SPIN ORDERING. Bennemann, K. H. (Univ. of Rochester, N. Y.); Mueller, F. M. Phys. Rev., 176: 546-55(Dec. 10, 1968).

It is shown that spontaneous and also a magnetic-field-induced ordering of the paramagnetic impurity spins in superconductors gives rise to an anomalous temperature dependence of the electronic thermal conductivity. (auth)

10591 SUPERCONDUCTIVITY OF α-PHASE U-Mo ALLOYS AT ZERO AND HIGH PRESSURES. Gordon, J. E. (Amherst Coll., Mass.); Gardner, W. E.; Smith, T. F.; Chu, C. W.; Maple, M. B. Phys. Rev., 176: 556-61(Dec. 10, 1968).

Heat-capacity measurements and determinations of the superconducting transition temperature as a function of applied pressure up to 10 kbar have been made on a number of α-phase uranium-molybdenum alloys. Small additions of molybdenum rapidly change the superconducting properties of the α phase. The strong initial pressure dependence of T_c for pure α-U is destroyed, and bulk superconducting behavior at zero pressure develops. (auth)

10592 PRECISION MEASUREMENT OF ANISOTROPY IN THE UPPER CRITICAL FIELD OF SUPERCONDUCTING NIOBIUM. Farrell, D. E.; Chandrasekhar, B. S.; Huang, S. (Case Western Reserve Univ., Cleveland). Phys. Rev., 176: 562-6(Dec. 10, 1968).

A sensitive vibrating-coil magnetometer has been employed to investigate anisotropy in the upper critical field of pure niobium from 1.2°K to the transition temperature. The results are analyzed using a four-term Kubic harmonic expansion. This is sufficient to represent the data to within experimental error above a reduced temperature of $t \simeq 0.5$, although as the temperature is reduced, small but systematic deviations occur, indicating the presence of higher harmonics. The temperature dependences of the first four harmonics are presented and discussed. Both the temperature dependence of the nth harmonic, and the reduction of that harmonic by impurity scattering, increase as n increases. The observations are in qualitative accord with the detailed theory for upper-critical-field anisotropy due to Hohenberg and Werthamer. Where direct comparison is possible, quantitative agreement is also obtained. (auth)

10593 FLUXOID QUANTIZATION AND FIELD-INDUCED DEPAIRING IN A HOLLOW SUPERCONDUCTING MICROCYLINDER. Groff, R. P.; Parks, R. D. (Univ. of Rochester, N. Y.). Phys. Rev., 176: 567-80(Dec. 10, 1968).

Little and Parks demonstrated that the superconducting transition temperature T_c of a multiply connected superconductor is periodic in a magnetic field with a periodicity of hc/2e. However, there were certain anomalous features of the early experiments, such as an unexplained temperature dependence of the amplitude of the ΔT_c oscillations and an unexplained nonoscillatory magnetic field background superposed on the oscillatory field dependence of T_c. By repeating the experiment under more controlled conditions, the problems which led to the anomalous features of the early results were eliminated. Isothermal resistance-versus-magnetic-field measurements were made on Sn and Al cylinders of various diameters in the range 1-5 μ. From these measurements, detailed phase diagrams (T_c-versus-H curves) were constructed which are in excellent agreement with the predictions of the linearized Ginzburg-Landau theory. The present type of experiment is shown to be suitable for studying depairing due to kinetic-energy effects associated with the drift motion of Cooper pairs. The results are discussed within the framework of the pair-breaking theory of Abrikosov and Gor'kov, which has been adapted to treat the present problem. (auth)

10594 HIGH-FREQUENCY SURFACE IMPEDANCE OF DIRTY TYPE-II SUPERCONDUCTORS IN THE SURFACE-SHEATH REGIME. Fischer, Gaston (RCA Labs. Ltd., Zurich); Maki, Kazumi. Phys. Rev., 176: 581-9(Dec. 10, 1968).

Surface-resistance measurements in the superconducting surface-sheath regime of Pb-In and Pb-Bi alloys are analyzed in the light of the recent theories of dirty type-II superconductors. From the changes of slope of the surface resistance R(H) at H_{c3}, the temperature dependence of the κ_2 parameter can be deduced. For the alloys investigated, it is found that κ_2 varies more strongly with temperature than expected from the dirty-limit theory. It is believed that this reflects strong-coupling effects. From the value of R(H) at H_{c2}, the absolute value of the sheath thickness can also be derived. This is found to agree well, near T_c, with the theoretical predictions of Fink and Kessinger. The analysis of the experimental data suggests that weak-coupling formalism remains applicable in the strong-coupling limit, and that deviations appear as modified temperature dependences of the critical fields. The $H_{c3}(t)$ and $H_{c3}(t)$ found for the two alloys are nevertheless rather close to the weak-coupling predictions. (auth)

10595 EFFECT OF ORBITAL QUANTIZATION ON THE CRITICAL FIELD OF TYPE-II SUPERCONDUCTORS. Gruenberg, L. W. (Massachusetts Inst. of Tech., Cambridge); Gunther, L. Phys. Rev., 176: 606-13(Dec. 10, 1968).

The effect of the discreteness of the Landau levels on the upper critical field of a type-II superconductor is discussed. At T = 0°K, an ideal superconductor will remain superconducting in an arbitrarily large magnetic field. However, the high-field state is destroyed by a minute amount of impurity scattering or by a small misalignment of up- and down-spin Landau levels. The residual effects are (a) a small shift in the low-temperature critical field $[\Delta H_{c2}/H_{c2} \approx (k_F \ell_0)^{-1}]$ and (b) oscillatory structure in the transition temperature $T_{c2}(H)$ for temperatures $T \lesssim \hbar\omega_c / 2\pi^2 k$. (auth)

10596 MICROWAVE PROPERTIES OF GRANULAR SUPERCONDUCTORS. Cohen, Roger W.; Gittleman, J. I. (RCA Labs., Princeton, N. J.). Phys. Rev., 176: 500-2(Dec. 10, 1968).

The microwave properties of a superconductor composed of small grains separated by tunneling barriers are calculated. In the absence of dc current, the ac conductivity is identical to that of a dirty superconductor. In the case of a nonvanishing current, the change in the conductivity due to the discontinuity in the phase of the energy-gap function across the tunneling barriers is smaller than that due to ordinary pair breaking. (auth)

10597 CRITICAL PHENOMENA. Proceedings of a Conference Held in Washington, D. C., April 1965. Green, M. S.; Sengers, J. V. (eds.). Washington, D. C., National Bureau of Standards, 1966. 253p. GPO $2.50. (NBS-MISC. PUBL.-273; CONF-650428).

Critical points of liquid vapor transitions, consolute points in binary liquid mixtures, Curie and Néel points in magnetism, second order phase transition points in solids, λ-points in liquid helium together with the anomalous phenomena which occur in their neighborhood were the subjects of the conference. Sessions were held on equilibrium critical phenomena in fluids, critical phenomena in ferro- and antiferromagnets, logarithmic singularities, elastic and inelastic scattering, and transport and relaxation phenomena. (W.D.M.)

Plasma and Thermonuclear Physics

10598 (AED-C-3-25) PLASMA PHYSICS INDEX. EXPERIMENTAL AND THEORETICAL PLASMA PHYSICS. Volume 3, No. 10. Bibliography; Author Index; Subject Index. Hilsenbeck, D. (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 28p. Dep.

439 articles on various aspects of plasma physics are listed. Subject and author indexes are included. (M.O.W.)

10599 (NP-17603) METHOD FOR MATCHING A PLASMA-LOADED HIGH FREQUENCY COIL TO A GENERATOR. Siller, G. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Nov. 1967. 32p. (In German). Dep.

A method is described to match a plasma-loaded high-frequency coil to a generator. In detail the possible electric circuits are discussed, which allow this matching. It is shown, that in the general case, one must use at the minimum two reactances for the transformation of the coil impedance. For this there are four possible circuits, which are investigated to their applicability. The computation of the circuits is made graphically by means of the inversion diagram. (auth)

Confinement and Heating

10600 (LA-4042) CHARACTERISTICS OF THE SCYLLA IA THETA PINCH WITH CROWBAR. Finlayson, Val A. (Los Alamos Scientific Lab., N. Mex.). Nov. 1968. Contract W-7405-eng-36. 117p. Dep. CFSTI.

Thesis. Submitted to Univ. of Utah, Salt Lake City.

The plasma and machine characteristics of the 96-kJ Scylla IA theta pinch are described. In contrast to previous theta pinches which employ single-turn coils for magnetic compression, Scylla IA has a two half-turn coil system which attains a voltage doubling effect. This produces a higher electric field E_θ = 1.33 kV/cm. Energy is stored in two 50-kV primary-capacitor banks consisting of 18 low-inductance 2.1-μF capacitors each. The energy is transferred to the half-turn coil system through 216 parallel low-inductance coaxial cables. The magnetic field rises to peak value in 1.7 μsec, at which time it is crowbarred by a fast metal-to-metal solid-dielectric shorting switch. The switch closes in 5.5 μsec with a shot-to-shot variation in closing time of ±0.05 μsec. With 48-kV operation of the primary bank, the switch carries approximately 1.8 MA with a 1/e-decay time constant of better than 800 μsec. The Scylla IA plasma β, density, and temperature are obtained from three-coordinated plasma-diagnostic experiments consisting of (1) a differential magnetic loop-probe measurement that determines total flux excluded by the plasma, (2) side-on measurement of the profile of light emitted by the plasma that yields the relative density, and (3) a gas-laser-interferometer measurement that gives the absolute density integrated through the plasma. In the low pressure regime ($P_{initial}$ = 24-mtorr), typical measured values are $\beta = 0.67 \pm 0.10$ and $n_e = n_i = 3 \times 10^{16}$ cm^{-3} on axis and $T = T_i + T_e = 3$ keV. Because of its faster initial compression of plasma, Scylla IA is well suited for studying the initial implosion phase and shock heating in a theta pinch. (auth)

10601 (MATT-659) A CURSORY LOOK AT TOKAMAK FUSION REACTORS. Mills, R. G. (Princeton Univ., N. J. Plasma Physics Lab.). Dec. 1968. Contract AT(30-1)-1238. 15p. Dep. CFSTI.

Hypothetical fusion reactors of the Tokamak and stellarator types are extremely similar. The similarities include the following five points. (1) A toroidal vacuum chamber is required, of low aspect ratio. (2) A divertor is needed. (3) A cold fuel injection system is assumed. (4) Auxiliary plasma heating apparatus is required for ignition. (5) They must operate at a particular value of the product of ion density and confinement time. The differences are: (1) The induced plasma current in a Tokamak supplants the use of helical windings in the stellarator; (2) Cyclic operation is necessary for Tokamaks; and (3) Tokamaks may require a lower β than stellarators. Difference number one could be an important advantage for Tokamaks, while difference number two may be only a small disadvantage since the duty cycle should be high. Difference three may be important. (auth)

10602 (ORO-3777-1) ION HEATING AT THE ELECTRON-ION HYBRID RESONANCE FREQUENCY. Haas, G. M.; Eisner, M. (Houston Univ., Tex.). Nov. 1, 1968. Contract AT-(40-1)-3777. 15p. (CONF-681112-1). Dep. CFSTI.

From Annual Meeting of the Division of Plasma Physics, Miami Beach, Fla.

Significant ion heating at plasma densities up to 3×10^{10}/cm^3 was produced by resonant electric fields generated by a modulated electron beam traversing the plasma. The ion heating takes place when the plasma column is driven at one of its natural resonances—the electron-ion hybrid resonance. There are indications that ion heating can be achieved at higher densities simply by raising the modulation frequency. (auth)

10603 (ORO-3777-2) ION HEATING BY INHOMOGENEOUS TIME VARYING ELECTRIC FIELDS. Lautzenhiser, T. V.; Eisner, M.; Haas, G. (Houston Univ., Tex.). Nov. 1, 1968. Contract AT(40-1)-3777. 13p. (CONF-681112-2). Dep. CFSTI.

From Annual Meeting of the Division of Plasma Physics, Miami Beach, Fla.

Results of calculations of single ion dynamics for an ion interacting with the field of a modulated electron beam in a beam formed magnetoplasma exhibit ion heating for modulation frequencies several times the ion cyclotron frequency, as observed by Haas and Dandl. The greater the electric field gradients, the higher the frequency at which significant ion heating is calculated. Ion heating may then be useful in determining plasma dielectric properties. (auth)

10604 KINETIC THEORY OF A CONFINED PLASMA. Romanov, Yu. A. (Radiotechnical Inst., Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1533-43(1968). (In Russian).

The surface impedance of a half-confined uniform isotropic plasma at three types of interaction between plasma particles and its surface (mirror reflection and two types of diffusion reflection) are found. The spectrum of the surface waves as well as the penetration into plasma and reflection of volume E-waves from it are examined on the basis of these impedances. The effective boundary condition permitting the solution of a number of concrete problems in a quasi-hydrodynamic approximation have been obtained. The examination of different boundary conditions allows: (1) clarification of the influence of one or the other factor of interaction between the plasma particles and the plasma boundary upon its electromagnetic properties, and (2) universal properties of the bounded plasma, i.e., those which depend slightly on a specific type of boundary condition, to be found. (auth)

10605 PULSE HEATING OF PLASMA IN HIGH-PRESSURE ELECTRODELESS DISCHARGES. Mitin, R. V.; Pryadkin, K. K. Zh. Tekh. Fiz., 38: 1727-30(Oct. 1968). (In Russian).

Experimental results are presented for the heating of high-pressure electrodeless-discharge plasma by a pulsed magnetic field of ~10 kG with period of ~8 μsec. The pulse strength of the light signal increases by 50 to 100 times, after which the prolonged afterglow is observed. Effective recombination coefficients for different gases at pressures from 1 to 4 atm, are estimated. These coefficients are compared with earlier data. (tr-auth)

10606 MAGNETO-INERTIAL CONFINEMENT OF A PLASMA CREATED BY THE INTERACTION OF LASER RADIATION WITH A GRANULE OF SOLID DEUTERIUM. Tonon, G.; Cognard, D.; Delmare, C.; Genevey, P.; Martineau, J.; Rabeau, M.; Vedel, J. M. Bull. Inform. Sci. Tech. (Paris), No. 130, 19-35(Oct. 1968). (In French).

The theoretical aspect of the confinement by a high magnetic field (1 to 2 MG) of a laser-created plasma is envisaged. The theoretical model leads to a final plasma temperature of 500 eV. The experimental device called POLCA used to test this model

involves a solid deuterium pellet immersed in a 0.5- to 1-MG field onto which is focused the beam of a 6-GW neodymium glass Q-switched laser. (auth)

Diagnostics

10607 (TID-24891) [PROGRESS REPORT ON APPLICATIONS OF LIGHT SCATTERING TO PLASMA DIAGNOSTICS]. (Maryland Univ., College Park). Dec. 1968. Contract AT(40-1)-3393-3. 7p. Dep. CFSTI.

This report consists of: (1) A status report on the measurement of excitation rate coefficients for lithium-like ions. (2) A status report on the high-electron-density–low-temperature light-scattering experiment. (auth)

10608 INFINITE CYLINDRICAL ANTENNA IN A UNIAXIAL COMPRESSIBLE PLASMA. Miller, E. K. (MB Associates, San Ramon, Calif.). Can J. Phys., 46: 2846-8(Dec. 15, 1968).

Numerical values are given for the admittance of an infinite cylindrical antenna in a uniaxial plasma, taking into account both plasma compressibility and a vacuum sheath. The susceptance is found to exhibit no significant sheath or compressibility dependence above the plasma frequency (f_p) and only a slight dependence on these factors below f_p. The conductance behavior shows no significant influence of compressibility or sheath in the range centered about f_p in which it is relatively constant in value except for a slight minimum at f_p. (auth)(Canada)

10609 SIMULTANEOUS, LOCAL MEASUREMENT OF TWO MAGNETIC FIELD COMPONENTS AND THE SUM OF THEIR SQUARES. Jones, I. R.; Peiry, J.-M.; Cocq, D. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Rev. Sci. Instrum., 40: 133-9(Jan. 1969).

An apparatus is described which is capable of measuring simultaneously the local amplitudes of two magnetic field components, their squares, and the sum of their squares. It consists of a two-coil magnetic probe and a voltage signal squaring circuit. Details of the construction and calibration of the apparatus are given and an application of the complete system is briefly outlined. (auth)

10610 PLASMA DIAGNOSTICS. Lochte-Holtgreven, W. (ed.). New York, John Wiley and Sons, Inc., 1968. 943p. $38.50.

This book provides an up-to-date account of the major theoretical and practical aspects of the diagnostics of high-temperature plasmas with special emphasis on quantitative spectroscopic methods. The different chapters were written by specialists actively engaged in research in these fields. The first two chapters contain a survey of the experimental methods of plasma analysis, together with the necessary theoretical background. In addition to chapters on spectroscopic, microwave and laser techniques, discussions of the electric and magnetic probe methods and mass spectroscopy have also been included. The evaluation of collision and transport cross sections, heat conductivity, electrical conductivity, and viscosity are some of the many applications of plasma diagnostic, reviewed here. (auth)

10611 CO_2-LASER INTERFEROMETER FOR THE MEASUREMENT OF TRANSIENT LOW-DENSITY PLASMAS. Herold, H.; Jahoda, F. C. (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instrum., 40: 145-7(Jan. 1969).

A coupled cavity CO_2-laser interferometer is described. The feedback is achieved either with (a) a rotating corner mirror or (b) an oscillating mirror. For method (a) a sensitivity of $\int ndl \geq 5 \times 10^{14}$ cm^{-2} and time resolution of 0.2 μsec is obtained. Method (b) is more sensitive ($\int ndl \geq 10^{13}$ cm^{-2}) but the time resolution is limited by the fact that signal amplitudes are strongly frequency dependent above 350 kc. The interferometer has been used to measure plasma densities of the Scylla IA θ pinch. (auth)

10612 SYNTHESIZED PLASMA GENERATOR. Rajangam, K. B.; Page, J. O.; MacKenzie, K. R. (Univ. of California, Los Angeles). Rev. Sci. Instrum., 40: 155-8(Jan. 1969).

A cesium plasma with a useful volume of 3 by 15 cm is produced inside a hot cylindrical tantalum cavity at temperatures around 1400 K. Ions are produced by contact ionization at the wall while electrons are obtained from an internal filament. The plasma potential determines the energy of the electrons, and this can be varied such that the electron–ion temperature ratio ranges from 1 to 2.4. In the vicinity of 10^{11} ions/cc the background noise is about the same as found in Q machines. (auth)

10613 COMPOSITION OF AN ARGON PLASMA IN SAHA EQUILIBRIUM. Chowdhury, S. S. (Imperial Coll. of Science and Tech., London). J. Quant. Spectrosc. Radiatiave Transfer, 9: 129-35(Jan. 1969).

A computer program in FORTRAN IV for the solution of a set of Saha equations is described. Also described are the physical assumptions used and reasons for choice of parameters, and expressions for the depression of ionization potential and partition functions. The computer output giving representative compositions of an argon plasma between 5000 and 45,000°K and at an electron density of 10^{17} to 10^{19} is presented in tabular form. (auth)(UK)

10614 STUDIES OF TOTAL EMISSION OF DENSE LOW-TEMPERATURE ARGON PLASMA. Loginov, A. A.; Matalova, O. L.; Lamonov, V. M. (State Inst. of Applied Chemistry, Leningrad). Teplofiz. Vys. Temp., 6: 1132-4(1968). (In Russian).

A fixed discharge between upper and lower electrodes was studied with arc current from 10 to 40 A at 6-mm arc length. The distribution of temperature along the argon arc radius was measured with a semiconductor bolometer and thermal radiometer which were positioned at opposite sides of the arc and at right angles to each other. A special bolometric method for measuring arc dicharge with unstable positive column was developed. Spectrum of argon plasma at I = 10 A and P ≃ 1.6×10^7 n/m^2 is presented. The results of the two measurements were in good agreement. Data obtained indicated that, in the range of investigated currents and pressures, the emissive power of argon increased with increases of current and gas pressure. (R.V.J.)

10615 COMMENTS ON ION MICROFIELD DISTRIBUTIONS AS USED IN PLASMA LINE BROADENING THEORIES. Smith, E. W. (National Bureau of Standards, Boulder, Colo); Hooper, C. F. Jr. J. Quant. Spectrosc. Radiative Transfer, 8: 1617-19 (Sept. 1968).

It is shown that the use of an extended ion microfield function gives rise to improved line shapes in the transition region between the line center and the asymptotic wings. (auth) (UK)

10616 HIGH-RESOLUTION MEASUREMENTS OF PLASMA DENSITY. Watson, J. L.; Beach, A. D. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Phys., D (London), 2: 129-33(Jan. 1969).

Simultaneous measurements of the electron density and temperature distributions in a theta-pinch plasma were made. The technique was based on the Thomson scattering of laser light and made use of a spectrometer originally designed to measure absolute electron temperatures. Data were obtained by scanning the instrument over the plasma column and taking measurements of the scattered light and the plasma bremsstrahlung. Density and temperature distributions in plasma columns of 1-cm radius, 10^{16} electrons/cm^3 density, and 100 eV temperature were resolved with an accuracy to 15%. (auth) (UK)

10617 DISPERSION-CORRECTED THREE-WAVELENGTH LASER HETERODYNE MEASUREMENT OF PLASMA DENSITIES. Liu, C. S.; Verdeyen, J. T.; Cherrington, B. E. (Univ. of Illinois, Urbana). Contract AF 33(615)-5248. J. Appl. Phys., 40: 201-7(Jan. 1969).

A three-wavelength laser heterodyne system for plasma diagnostics has been developed using the 0.6328, 1.15, and 3.39 μ transitions in He–Ne. In order to use the 3.39 μ transition, an experimental technique has been developed to measure the dispersion introduced by the lasering atoms under the same conditions that are used for plasma measurements. The dispersion-corrected 3.39 μ data, when combined with the data at 1.15 and 0.6328 μ, give excellent agreement in the measurement of temporally and spatially resolved electron densities and changes in neutral densities in the afterglow of a pulsed argon discharge. The electron-density measurements agree with integrated electron-density measurements made with a microwave cavity operating in the TM_{010} mode. (auth)

10618 MASS-SPECTROMETER ANALYSIS OF A CESIUM PLASMA. Witting, H. L. (General Electric Research and Development Center, Schenectady, N. Y.). J. Appl. Phys., 40: 236-41(Jan. 1969).

An experiment has been performed in order to determine the dominant ionic species in a cesium plasma in the torr pressure range. The device consists of a planar thermionic converter with a small (25 μ dia) hole in the collector. Ions that pass through the hole are accelerated by an ion gun and analyzed in a magnetic mass spectrometer. It is found that atomic cesium ions are the dominant species in both the ignited and unignited modes of operation of the discharge. The molecular cesium ions Cs_2^+ and Cs_3^+ were also detected in the ignited mode. In addition, measurements were made of the total ion and electron currents that pass through the collector hole. Here the hole acts as a probe of the plasma adjacent to the collector. (auth)

10619 PERTURBATION OF MICROWAVE CAVITIES BY LOSSY DIELECTRICS AND PLASMAS. Hall, Richard B. (Boeing Scientific Research Labs., Seattle). J. Appl. Phys., 40: 30-6 (Jan. 1969).

The frequency shift and Q change of a microwave cavity caused by lossy dielectrics or plasma spheres or cylinders is calculated. The necessity for this analysis is prompted by the use of microwave cavities to measure the expansion of nearly spherical plasmas created by focused high-power lasers. The conditions required for the perturbing volume to behave as if it were a perfect conductor are examined. It is found that much lower conductivities (or permittivities) are required when the perturbing volume is placed in a cavity region where electric energy is predominant. (auth)

10620 MICROWAVE MEASUREMENTS ON LASER-PRODUCED BLAST WAVES. Hall, Richard B. (Boeing Scientific Research Labs., Seattle). J. Appl. Phys., 40: 36-43(Jan. 1969).

The expansion of a laser-produced blast wave is measured by creating a laser spark at the center of a microwave cavity. The radius measurement as a function of time is accomplished by measuring the cavities' resonant frequency shift. In addition, the blast-wave surface temperature and electron density can be deduced by measuring the change in Q of the cavity. The results are in general agreement with ideal blast-wave theory. (auth)

10621 DIAGNOSTICS OF A PLASMA IN A MAGNETIC FIELD WITH THIN CYLINDRICAL PROBES. Kagan, Yu. M.; Perel, V. I. Zh. Tekh. Fiz., 38: 1663-6(Oct. 1968). (In Russian).

It is shown that the usual Langmuir method for treatment of electron probe characteristics with negative probe potentials can be used in the presence of magnetic fields if a thin cylindrical probe is used and oriented perpendicular to the field. The criterion of applicability is the smallness of probe radius in comparison with the Larmor radius. (tr-auth)

10622 SPECTROSCOPIC INVESTIGATION OF THE HIGH-DENSITY PLASMA FROM EXPLODED LITHIUM WIRES. Ya'akobi, B. (Hebrew Univ., Jerusalem). pp 87-92 of Exploding Wires. Vol. 4. Chace, William G.; Moore, Howard K. (eds.). New York, Plenum Press, 1968.

From 4th Conference on the Exploding Wire Phenomenon, Boston. See CONF-671044.

Once the physical properties of the plasma produced by exploding wires are determined, some general phenomena characteristic of high-density plasmas can be investigated. Two examples are given here to demonstrate such a possibility. The first one employs the absorbed lines of the 2S–nP series of lithium for a new method of determining the time-averaged electron concentration as a function of the distance from the wire axis. The second example deals with the transition from quadratic to linear Stark broadening of the 2P–5D line of lithium. (M.H.R.)

10623 MICROWAVE SCATTERING BY TURBULENT PLASMA. Stott, P. E. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J; Phys. A (London), 2: 75-86(Jan. 1969).

Microwave transmission across a column of turbulent plasma is strongly influenced by the presence of small-scale plasma density inhomogeneities. In devices such as Zeta, fluctuations of 10 to 25% about mean densities of 10^{14} cm^{-3} have been observed with correlation lengths of up to 5 to 10 cm and time scales of 10^{-5} s. Scattering measurements have used microwaves with a free-space wavelength of 2 mm (corresponding to a critical density of 2.5×10^{14} cm^{-3}) and in Zeta multiple-scattering processes are important. A numerical solution for the transport theory formulation of multiple scattering is used to interpret the measurements, and good agreement with Langmuir probes is obtained. (auth) (UK)

10624 ULTRA-FAST HOLOGRAPHY. Buges, J. C.; Terneaud, A. Bull. Inform. Sci. Tech. (Paris), No. 130, 53-9(Oct. 1968). (In French).

This paper is devoted mainly to pulsed holography of stationary phenomena and pulsed interferometric holography of laser-created plasmas. The source is a conventional q-switched ruby laser of which spectral coherence is 5×10^{-2} Å and spatial coherence is 10^{-4} rad. The energy output is one joule. Optical devices will be described. Wave reconstruction is obtained by means of an ordinary helium–neon gas laser. This technique has been applied to plasma interferometry; two ruby lasers are Q-switched by the same rotating prism. Focusing of one of the laser beams creates an air spark. The other laser operating in a double pulse mode is used as the diagnostic source. Investigations towards large-field depth holography are also presented. (auth)

10625 EVALUATION OF AN ARGON PLASMA WITH THE AID OF CONTINUOUS RADIATION. Gundel, H.; Neumann, W. Monatsber. Deut. Akad. Wiss. Berlin, 9: 604-8(1967). (In German).

Based on data on the temperature-, density-, and frequency-dependence of the spectral emission coefficient (ϵ_ν) in the 2700 to 5000-A wavelength and 11,000 to 14,000°K temperature range and on the data for the 5000 to 6800-A wavelength range, the temperature T can be determined from the value of ϵ_ν if the $N_0(T)$ relation (N_0 is the product of ion and electron density; T is the temperature) is known. (ATD) (TSS)

Kinetics

Refer also to abstracts 10481, 10536, 10673, and 10683.

10626 (D-1-82-772) PLASMA EFFECTS IN SEMICONDUCTORS. Ancker-Johnson, Betsy (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Oct. 1968. 43p. (CONF-680716-2).

From 9th Conference on the Physics of Semiconductors, Moscow, USSR.

The review begins with a survey of nonequilibrium plasma production methods and the properties of such plasmas in their as-produced state. The methods are injection, impact ionization, and two-photon absorption. The description of the as-produced properties includes previously unpublished information about plasma distribution during injection and characteristic times involved in plasma decay. Two plasma effects beyond those associated with plasma production are discussed in detail, namely, the pinch effect and microwave radiation. The status of the theories and experiments describing pinch formation and its properties thereafter are critically examined so that the open questions emerge. No theory for microwave radiation exists. The plethora of observations are grouped into four sets of characteristics: the threshold conditions, the spectrum of the radiation, its polar dependence, and the attendant low frequency (MHz) resistance oscillations. Recent experiments show that a magnetic field is not essential for emission, and some simple, reasonable arguments about the role of a magnetic field in producing radiation, if true, reconcile the conflicting reports concerning the four sets of characteristics. (auth)

10627 (D-1-82-774) EXACT SOLUTION OF A ONE-DIMENSIONAL ELECTRICAL TRANSPORT PROBLEM WITH ELASTIC AND INELASTIC SCATTERING. Gerwin, Richard A. (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Nov. 1968. 47p.

A gas of charged particles making both elastic and inelastic collisions is assumed to be in a uniform steady state in a uniform steady electric field. Supporting that the gas obeys a one-dimensional Boltzmann equation, this equation is solved exactly for the case of energy-independent elastic and inelastic mean free paths, together with the assumption of isotropic scattering. The gas drift velocity and gas temperature are then obtained from the velocity distribution, their dependences on electric field strength are displayed. The results are in good qualitative agreement with other theories and with experiments on n-type germanium at liquid nitrogen temperature. (auth)

10628 (IPP-3/78) ARC PHENOMENA AND GASDYNAMIC EFFECTS DUE TO INTERACTION OF SHOCK WAVES WITH MAGNETIC FIELDS. Klingenberg, H. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Aug. 1968. 42p. Dep.

The arc phenomena occurring on interaction of shock-heated plasma with a magnetic field were studied in order to achieve an approximately uniform current distribution in a certain volume using a number of small electrodes. This is necessary for producing plane gasdynamic effects such as reflected shocks and one-dimensional flow behind them in order to compare experimental results with theory. The current amplitude depends on the surface area and the number of electrodes. It is governed by the complex boundary conditions in the plasma-to-electrode transition, which consists of narrow current channels leading to arc spots. The properties observed agree with those of normal arcs described in the literature. Owing to the complexity of the phenomena it is not possible to explain the results quantitatively. They can, however, be explained qualitatively by comparing them with those described in the literature on normal arcs. The real aim to fill an interaction volume with current as uniformly as possible seems to have been achieved. Image converter pictures show a rather homogeneous incandescence in the interaction region. The retarding force per unit area $\vec{j} \times \vec{B} \cdot L$ acting on the supersonic plasma flow is of the order of the total hydrodynamic pressure of the flow. Streak photographs show that the flow is slowed down, and reflected fronts are observed. Strictly speaking these are not shock fronts, but they can be interpreted as the plasma fronts that follow shock fronts in case of relaxation. At lower initial pressure, for instance at 0.5 torr, the reflected front is again reflected at the contact front. (auth)

10629 (IPP-3/79) AN INTERFEROMETER FOR THE MEASUREMENT OF THE FRESNEL DRAGGING EFFECT ON MICROWAVES BY A DRIFTING ELECTRON PLASMA. Gehre, O.; Mayer, H. M.; Tutter, M. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Sept. 1968. 16p. (In German). Dep.

An apparatus is described which measures deviations from reciprocity in the propagation of electromagnetic waves traveling through a medium. The medium under test was a plasma. The apparatus was built for 3-cm waves. The minimum detectable phase difference between the two directions was $\sim 2 \times 10^{-3}$ degrees. (auth)

10630 (SU-IPR-250) EXPERIMENTAL VERIFICATIONS OF MICROSCOPIC PLASMA THEORY. Crawford, F. W. (Stanford Univ., Calif. Inst. for Plasma Research). July 1968. Contracts AT(04-3)-326; DA-28-043-AMC-02041(E). 38p. (CONF-680830-1). Dep. CFSTI.

From International Symposium on One Particle Distribution Functions in Plasmas, Marburg, Germany.

One of the ways in which the detailed shape of the charged-particle velocity distribution function in a plasma may manifest itself is in the dispersion characteristics of plasma-wave propagation. Indeed, several phenomena, e.g., Landau damping, cyclotron damping, and cyclotron harmonic waves, can only be predicted from a microscopic theory of the propagation. In recent years, experimental agreement with theory based on the Vlasov equation has been demonstrated for such phenomena with a high degree of accuracy for Maxwellian plasmas, in the small-signal propagation limit. This paper reviews some of the work already carried out, and then discusses some likely future developments in the comparison of theory and experiment for situations where the small-signal approximation breaks down. Some relevant results on wave/wave interaction are described. (auth)

10631 (SU-IPR-253) PARAMETRIC AMPLIFICATION OF CYCLOTRON HARMONIC WAVES IN PLASMA. Harker, K. J.; Crawford, F. W. (Stanford Univ., Calif. Inst. for Plasma Research). July 1968. Contract AT(04-3)-326. 4p. (CONF-680935-1). Dep. CFSTI.

From 7th International Conference on Generation and Amplification of Microwaves and Light Waves, Hamburg, Germany.

An analysis is presented of the nonlinear interaction between cyclotron harmonic waves propagating perpendicular to the static magnetic field in a warm magnetoplasma. It is demonstrated that the synchronism conditions for traveling-wave parametric amplification, and passive-mode conversion, can be satisfied for such waves, and an analysis is carried out for a large-signal pump wave interacting with two small-signal waves. Growth rates and corresponding pump powers are computed, and it is concluded that the effect should be observable in typical laboratory plasmas. A discussion of possible device applications is also given. (auth)

10632 (SU-IPR-265) ION WAVES, DRIFT WAVES, AND INSTABILITY IN A WEAKLY IONIZED MAGNETOPLASMA. Self, S. A. (Stanford Univ., Calif. Inst. for Plasma Research). Nov. 1968. Contract AT(04-3)-326. 66p. Dep. CFSTI.

A comprehensive treatment is given of low-frequency wave propagation in a weakly ionized magnetoplasma from the fluid equations in which ion inertia is retained. An analysis is made of the instabilities which arise due to the influence of drift of the electrons relative to the ions for three cases: (i) parallel drift, $E \parallel B$, (ii) Hall drift, $E \perp B$, and (iii) diamagnetic drift, $\nabla n \perp B$. In all cases, an ion-acoustic instability is found while additionally, for case (iii), there is a drift instability for strong magnetic fields. The instability boundaries in parameter space are delineated. Furthermore, for a transversely bounded plasma, the dispersion relations are solved both for $\omega(k_z$ real) and $k_z(\omega$ real) for points just below and just above the instability boundaries, and a discussion given of how these solutions are related to experimental observables. The results are applied to an interpretation of wave propagation and instability on a cylindrical positive column for which all three types of drift are simultaneously present. A discussion is also given of the relation of this work to the theories of the current-convective and crossed-field instabilities which neglect ion inertia and are consequently valid only for high pressures. (auth)

10633 RECOMBINATION AND BREMSSTRAHLUNG RADIATION OF ELECTRONS IN A FIELD OF O II AND N II IONS. Grenishin, S. G.; Nikolaevskii, L. S.; Simonenko, A. F. Zh. Prikl. Spektrosk., 8: 803-6(May 1968). (In Russian).

By a method of comparing the luminosities of standard and experimental sources, the emissive powers of nitrogen, oxygen, and air plasmas in the spectrum range 700 to 250 nanometers at a temperature from 21,000 to 32,000°K and electron concentration 3×10^{18} cm^{-3}, was measured. The working substance of the standard source was a hydrogen and helium plasma, whose luminosity was theoretically calculated. Experimental values obtained for a correction factor to the hydrogen-like theoretical solution for the standard intensity give good agreement between experimental and theoretical results. An increase in the emissive power of N_2 and O_2 in the blue part of the spectrum was established. (ATD)

10634 CONTRIBUTION OF PERTURBER RADIATION TO THE SHAPES OF SPECTRAL LINES BROADENED BY ELECTRON IMPACTS. Burgess, D. D. (Harvard Coll. Observatory, Cambridge, Mass. Imperial Coll. of Science and Tech., London). Phys. Rev., 176: 150-60(Dec. 5, 1968).

Theories of electron-impact broadening have previously neglected the radiation produced by the perturbing electrons. A theory is developed to take the perturber radiation into account, and so to evaluate possible interference terms. These may lead to observable asymmetries of lines of ionized emitters. (auth)

10635 RADIATIVE ION–ELECTRON RECOMBINATION IN A SODIUM-SEEDED PLASMA. Rothe, Dietmar E. (Cornell Aeronautical Lab., Inc., Buffalo, N. Y.). J. Quant. Spectrosc. Radiative Transfer, 9: 49-62(Jan. 1969).

Photoionization cross sections for the $3p^2p_{\frac{1}{2},\frac{3}{2}}$ state of sodium were measured in terms of a sodium line f-value in the region between 3000 and 4000 Å by analyzing the electron–ion recombination radiation emitted by a shock-heated sodium-seeded plasma. The results are compared with the quantum-mechanical predictions of Rudkjobing and Moskvin. The experimental cross sections were found to vary as the cube of the wavelength, with an absolute magnitude of 7.2×10^{-18} cm^2 at the continuum limit. It is shown how a knowledge of these cross sections, coupled with this experimental technique, can be used to determine unknown electron temperatures and concentrations. (auth)(UK)

10636 INTERACTION OF A HIGHLY RELATIVISTIC HELICAL ELECTRON STREAM AND A COLD MAGNETOACTIVE PLASMA. Fung, P. C. W. (Univ. of Montreal). Can. J. Phys., 47: 161-77(Jan. 15, 1969).

When a nearly monoenergetic relativistic electron stream is gyrating along a cold magnetoactive plasma with general pitch angle Φ (defined as the angle between the static magnetic field of the plasma and the momentum of a particle in the stream), the system is shown to be radiatively unstable with respect to synchrotron radiation. Using the classical kinetic approach, the temporal growth rate is derived for general wave-normal angle θ (defined as the angle between the static magnetic field and wave vector k). Deducing the spatial amplification rate from the temporal growth rate, the result obtained here is shown to be identical with that obtained from the Einstein-coefficients approach deduced by Fung earlier. (auth)(Canada)

10637 SOLUTION OF THE LINEARIZED VLASOV EQUATION WITH LENARD–BERNSTEIN COLLISION TERM. Bachmann, P. Monatsber. Deut. Akad. Wiss. Berlin, 10: 411-20 (1968). (In German).

The Landau initial value problem for the linearized Vlasov equation with Lenard–Bernstein collision term was solved with incorporation of a constant external magnetic field. The integral equation to be solved is derived, and the Volterra equation derived is solved. The application of the solution is discussed. (J.S.R.)

10638 RADIATION OF THE CONTRACTED ARGON COLUMN AT AVERAGE PRESSURE. Venzke, D.; Wojaczek, K. Monatsber. Deut. Akad. Wiss. Berlin, 10: 432-8(1968). (In German).

In order to gain data on the nature of the continuum radiation of the contracted column, transverse distributions of the surface beam density were measured in various spectral regions in the contracted argon column. Typical transverse distributions of the continuum and line radiation are shown. The results are discussed on the basis of assumptions made by Kagan and Wojaczek. The transverse distributions were calculated for five processes occurring in the column. (J.S.R.)

10639 DEVELOPMENT OF A THEORY TO DESCRIBE CONSTRICTED POSITIVE COLUMNS IN ALKALI-METAL-SEEDED RARE GASES. Ellington, H. I. (Robert Gordon's Inst. of Tech., Aberdeen, Scotland). J. Phys. D (London), 2: 65-71(Jan. 1969).

It is shown that four equations (covering respectively the electron energy balance, ion balance, current continuity and energy balance) are necessary and sufficient to describe the constricted positive columns of certain arc discharges in alkali-metal-seeded rare gases. The internal mechanisms and basic structural features of one such column are discussed in terms of the theory, which is shown to give a satisfactory explanation of the column properties. (auth) (UK)

10640 STUDY OF THE POST DISCHARGE OF A PLASMA PRODUCED BY LASER. Baravian, Gerard; Bretagne, Jean; Delcroix, Jean-Loup; Godart, Jean; Sultan, Gilbert (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 267: 639-42(Sept. 30, 1968). (In French).

Recombinations of the type $He^+ + e + e \rightarrow He(p) + e$ and $He^+ + e \rightarrow He(q) + h\nu$ in a plasma produced in helium by focusing of a laser beam were studied experimentally during the first 10 μsec of the post discharge. The electron density was determined, and the apparent total recombination coefficient γ_T and the radiative–collisional recombination coefficient γ_{RC} were measured and calculated. The values obtained are shown graphically. The values $10^{-13} < \gamma_{RC} < 10^{-11}$ cm^3 sec^{-1} were obtained for helium in the time interval considered. These values are compatible with measured values and confirm the radiative–collisional type of recombination in such a plasma. (J.S.R.)

10641 MAGNETIC PINCH EFFECT IN THE THERMAL rf INDUCTION PLASMA. Chase, J. D. (American Cyanamid Co., Stamford, Conn.). J. Appl. Phys., 40: 318-25(Jan. 1969).

The pinch effect or excess magnetic pressure is calculated and measured for an rf induction plasma in argon. This excess magnetic pressure (P_m), which hitherto has been overlooked in all previous investigations concerning the induction plasma, explains the reported anomalous flow behavior of the plasma torch. Theory for calculating P_m is given using a model of the plasma as a solid conductor of constant electrical conductivity. From current density and magnetic field distribution within the plasma, the local Lorentz force is evaluated, and summation across the plasma radius gives the maximum P_m at the center of the peripheral discharge path. Published values for coupling efficiency and temperature profile are employed in conjunction with measured oscillator circuit parameters in order to make the calculation. The calculated P_m at the center of a 4.7 MHz, 2.5 kW argon induction plasma in a 30 mm tube is 64.5 dyn/cm^2. At the center of the plasma, P_m was measured with a cooled probe and found to be 71.5 ± 3 dyn/cm^2. Although $P_m/P \approx 10^{-4}$, the magnetic pressure has an appreciable effect on the fluid mechanics of the discharge. The pinch or compressive force acts inward around the circumference, but not at the ends of the cylindrical plasma. Consequently, a magnetically induced flow occurs out from both ends of the plasma. (auth)

10642 EFFECT OF FINITE ION MASS ON THE STABILITY OF A SPACE-CHARGE-NEUTRALIZED ELECTRON BEAM. Faulkner, J. E.; Ware, A. A. (Aerojet-General Corp., San Ramon, Calif.). J. Appl. Phys., 40: 366-8(Jan. 1969).

The dispersion relation is derived for a finite length one-dimensional electron beam neutralized by positive ions with zero electron and ion temperatures. Contrary to previously published results it is shown that finite ion mass does not produce stability. There are two modes of instability, electron space-charge waves and ion oscillations. Their relative importance at different lengths is considered. (auth)

10643 STRIATION FORMATION DURING STEADY-STATE GLOW DISCHARGE. Palmer, J. D. (Union Coll., Schenectady, N. Y.). J. Appl. Phys., 40: 369-71(Jan. 1969).

The formation of striations in a normal glow discharge has been correlated with a relaxation-type phenomenon occurring at the cathode dark space–negative-glow interface and caused by cathode instabilities. A beamlike stream of electrons, in excess of that number necessary to maintain the normal glow brought about by cathode instabilities, is postulated to cross the cathode-fall region and to interact with neutrals in the negative glow causing a surplus of positive ions at the interface between the cathode dark space and the negative glow. This group of positive ions constitutes a positive striation which in turn is accelerated toward the cathode. The experimentally observed times for these striations to cross the cathode-fall region give a velocity of approximately 10^4 cm/sec, which is in good agreement with other observations of positive-ion striation velocities. (auth)

10644 PROPAGATION OF MAGNETOHYDRODYNAMIC WAVES IN INHOMOGENEOUS PLASMA WITH AXIAL SYMMETRY. Deutsch, R. V.; Ciubotariu, C. (Institutul Politehnic, Iasi). Stud. Cercet. Fiz., 20: 791-8(1968). (In Rumanian).

It was found that the inhomogeneity of magnetic fields does not influence the propagation of magnetohydrodynamic waves. Alfven oscillations of the total system were the result of local Alfven wave propagation in an axially symmetric field. Studies were made of propagation of cylindrical magneto-acoustic waves in the presence of cylindrically symmetric fields. Scattering of cylindrical magneto-acoustic waves around the symmetry axis is discussed and the behavior of the waves at large distances from the magnetic axis was analyzed. (tr-auth)

10645 RESONANCE OF GAS-DISCHARGE PLASMA IN A MAGNETIC FIELD. Gil'denburg, V. B.; Markov, G. A. Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 780-3(1968). (In Russian).

The absorption spectra of longitudinal waves propagating in an inhomogeneous plasma across a magnetic field was studied, using experimental data on resonance electromagnetic wave scattering by a positive gas-discharge column placed in a longitudinal magnetic field. The column was used for controlling gyrotropic plasma properties and its radial distribution in the discharge. (R.V.J.)

10646 EXCITATION OF LONGITUDINAL OSCILLATIONS IN A NONLINEAR MEDIUM BY MODULATED CURRENT. Demchenko, V. V. (Kharkov State Univ.). Ukr. Fiz. Zh., 13: 1878-82(1968). (In Russian).

The problem is considered on excitation of longitudinal oscillations in a nonlinear medium by the given modulated current of a finite value. A dependence is obtained of the field amplitude on the current one in cases of strong and weak currents providing the modulation frequency is close to the system resonance frequency. Nonlinear plasma and dielectric are considered as nonlinear media, the properties of the latter being well described in a two-level approximation. (auth)

10647 THEORY OF ELECTROMAGNETIC WAVE PROPAGATION IN NONLINEAR MEDIA. Bass, F. G.; Verbitskii, I. L.; Gurevich, Yu. G. (Inst. of Radiophysics and Electronics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1480-9(1968). (In Russian).

Possible stationary regimes arising from propagation of electromagnetic waves in a solid body and plasma, with the dielectric permittivity depending on the field modulus are studied. (auth)

10648 NONLINEAR WAVE INTERACTION IN RELATIVISTIC PLASMA. Tsytovich, V. N.; Korzhenevich, I. M. (Kharkov State Scientific Research Inst. of Metrology). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1505-21(1968). (In Russian).

The nonlinear effects in plasma consisting of ultrarelativistic electrons and nonrelativistic ions and of ultrarelativistic electron–ion plasma are considered. The distribution functions of plasma particles are assumed Maxwellian. The probabilities of nonlinear interactions of longitudinal and transverse waves between each other were found, as well as longitudinal waves with transverse waves. The interaction between waves with different phase velocities are considered. It is shown that a direct transformation of high-frequency waves into plasma waves may be effective. (auth)

10649 INVESTIGATION OF PLASMA COMPLEX CONDUCTIVITY IN LOW-FREQUENCY REGION. Aleksandrov, A. F.; Kuzovnikov, A. A. (Moscow State Univ.). Izv. Vyssh. Uchet Zaved., Radiofiz., 11: 1544-7(1968). (In Russian).

An experimental investigation was made of the dependence of active and reactive components of the impedance of a plane capacitor, the plates of which are in plasma and with the potential maintained to be equal that of the space, upon the plasma parameters when the field frequency is much less than the plasma frequency. Under the experimental condition, the capacitor impedance is completely determined by the value of the local plasma conductivity that permits one to calculate the effective collision frequency of electrons by the experimental data. The results agree satisfactorily with the data on the value of the effective collision frequencies obtained by independent way. (auth)

10650 INSTABILITIES OF PLASMA GENERATED BY BEAM-PLASMA DISCHARGE IN MAGNETIC MIRROR. Marinin, V. G. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 13: 1872-7(1968). (In Russian).

Plasma generated by a beam–plasma discharge with anticathode was investigated. Two different regimes for the beam–plasma system were observed. A dense hot-electron plasma was observed at the first regime. A low-density cold-electron plasma was noticed at the second regime. Transition of the beam–plasma system to the second regime is due to instability occurring in crossed electric and magnetic fields. (auth)

10651 INVESTIGATION OF SPACE CHARGE LAYERS BY THE PLASMA CAPACITOR METHOD. Aleksandrov, A. F.; Kuzovnikov, A. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1548-53(1968). (In Russian).

The measurement results of the layer thickness d_l of a space charge near the electrodes immersed into plasma are given. The measurements were carried out by the method of plasma capacitor. The dependence of the value d_l on the electrode potential V and plasma parameters are investigated. The experimental dependence of d_l on V is in good quantitative agreement with the theoretical one for the cases when there exist in the layer ion free

transit and mobility regimes. The experimental dependence of d_1 on the charged-particle density in a plasma does not agree with the theoretical one, due to the influence of the secondary processes. (auth)

10652 A NOTE ON ELECTROMAGNETIC MODE IN CONFINED PLASMA WAVEGUIDES. Lee, Kai Fong (National Center for Atmospheric Research, Boulder, Colo.). J. Appl. Phys., 40: 428-9(Jan. 1969).

The effect was studied of transverse density nonuniformity on the propagation of electromagnetic waves in cylindrical plasma waveguides immersed in an infinite axial magnetic field. The principal feature of the findings is that, contrary to the case with space-charge waves, the frequency of the electromagnetic mode is higher in a nonuniform waveguide than it is in a uniform one. This increase of frequency is inversely proportional to wave number. (M.O.W.)

10653 ELECTROMAGNETIC SCATTERING BY A SMALL PLASMA ELLIPSOID MOVING ALONG THE EXTERNAL STATIC MAGNETIC FIELD. Shiozawa, T. (Osaka Univ.). J. Appl. Phys., 40: 435-7(Jan. 1969).

The electromagnetic scattering by a small plasma ellipsoid that is moving uniformly in vacuum along the external static magnetic field and the effects brought about by the dispersion of plasma are investigated. The plasma is assumed to be cold and collisionless, being characterized electromagnetically in terms of an average macroscopic dielectric tensor. (M.O.W.)

10654 POWER RADIATED BY OSCILLATING MAGNETIC AND OSCILLATING ELECTRIC DIPOLES IN A COLD, STREAMING PLASMA. Bergeson, John E. (Boeing Scientific Research Labs., Seattle). J. Appl. Phys., 40: 152-8(Jan. 1969).

The power radiated by oscillating magnetic and oscillating electric point dipoles is calculated for the case where the dipoles are immersed in a cold, streaming plasma. The power output of the dipoles in a streaming plasma is less than it is in a stationary plasma, although the correction term is of order β^2, where β is the ratio of the plasma's streaming velocity to the velocity of light. The power output is calculated by a generalized Poynting vector method, using electromagnetic-field expressions derived from a set of linearized, covariant cold-plasma equations. The results of this paper are compared with the results of Daly, Lee, and Papas, and of McKenzie, who calculate the power output of the oscillating electric dipole from a "dispersive medium" point of view. (auth)

10655 INERTIAL PLASMA EFFECT IN GLOW DISCHARGES. Iorish, Yu. I.; Dotsenko, V. Ya. Zh. Tekh. Fiz., 38: 1667-74 (Oct. 1968). (In Russian).

The study confirms the existence of an inertial plasma effect in glow discharges. The damped oscillations of the plasma jet and if periodic effects are recorded. Amplitude–frequency and other characteristics of the oscillatory system formed by the jet, the medium, and the electric field in the tube with differential anodes were obtained. The natural frequency of the system was within the limits of 5 to 30 cycles/sec. Intensification of the effect, in the pressure region of the order of 10^{-1} atm, was related apparently to the constricted discharge and increased exchange of energy between the particles in the jet. (tr-auth)

10656 POSSIBILITY OF UTILIZATION OF PLASMA JETS FOR AMPLIFICATION OF RADIATION. Gol'dfarb, V. M.; Luk'yanov, G. A. Zh. Tekh. Fiz., 38: 1684-9(Oct. 1968). (In Russian).

The possibility of using high-speed plasma jets for the amplification of radiation is analyzed. Experimental and calculated data concerning the population of hydrogen levels in an argon–hydrogen jet are compared. The presence of field-inversion populations is shown. (tr-auth)

10657 CUTOFF OF PLASMA JETS BY TRANSVERSE MAGNETIC FIELDS. Gol'ts, E. Ya.; Khodzhaev, A. Z. Zh. Tekh. Fiz., 38: 1690-6(Oct. 1968). (In Russian).

The motion of plasma jets at constant and variable rates in transverse magnetic fields was examined. Partial recording of polarization of plasma particles escaping from the area of the magnetic field showed that some are deflected at greater angles; besides this, many particles are captured by the field. By proper actuation of the field, it was possible to cut off part of the jet and obtain short hydrogen clusters with density up to 1.5×10^{13} cm^{-3}. (tr-auth)

10658 IONIZATION IN PLASMA TOGETHER WITH MAXWELLIZATION OF FREE ELECTRONS. ESTIMATE OF THE IONIZATION OF CESIUM PLASMA. Baksht, F. G.; Moizhes, B. Ya.; Nemchinskii, V. A. Zh. Tekh. Fiz., 38: 1731-43(Oct. 1968). (In Russian).

Ionization and recombination in low-temperature plasma are considered, when these processes lead to the deviation of the distribution function of fast electrons from Maxwellian. An expression for the rate of the stepwise ionization is developed, when the ionization goes principally through the first excited level. Numerical results are conducted for low-temperature cesium plasma. (tr-auth)

10659 RESISTANCE OF PULSED PLASMA COLUMN DISCHARGES IN XENON-FILLED QUARTZ TUBES. Andreev, S. I.; Gavrilov, V. E. Zh. Tekh. Fiz., 38: 1697-1704(Oct. 1968). (In Russian).

Experimental work showed that the resistance of the discharge decreases sharply as the current goes from zero to its maximum value, after which it remains practically constant. A relationship is proposed for determining the resistance magnitude in terms of the amplitude, current pulse length, and the dimensions of the discharge tube. (tr-auth)

10660 THEORY OF ELECTRIC ARC COLUMN BURNING UNDER CONDITIONS OF NATURAL CONVECTION. II. Krinberg, I. A. Zh. Tekh. Fiz., 38: 1705-13(Oct. 1968). (In Russian).

Further development is proposed for the method of estimating parameters of an arc column that burns under conditions of natural convection. The calculated and experimental data for the arc column parameters in air, nitrogen, oxygen, hydrogen, and argon were compared for current strengths of 1 to 300 A at atmospheric pressure. Error estimation, using approximation methods, accounted for convective heat losses from the column. (tr-auth)

10661 NEAR-ELECTRODE PHENOMENA IN GAS DISCHARGES. Lebedev, A. D. Zh. Tekh. Fiz., 38: 1719-26(Oct. 1968). (In Russian).

Change of charged-particle concentration and electric field in the interelectrode interval is considered, with the calculation of diffusion, recombination, and partial ionization. On the basis of an equation obtained, volt–ampere characteristics of the discharge were constructed. (tr-auth)

10662 EXCITATION OF STANDING ION–ACOUSTIC WAVES IN WEAKLY IONIZED PLASMA. Barkhudarov, E. M.; Zhvaniya, B. P.; Kortkhondzhiya, V. P. Zh. Tekh. Fiz., 38: 1660-2(Oct. 1968). (In Russian).

The spontaneous excitation of standing ion–acoustic waves in weakly ionized plasma, created in a spherical discharge tube from an incandescent cathode, was studied. The observed frequency spectra are compared with calculated data, obtained for different values of the compression coefficient of an electron gas and the boundary conditions of the reflected waves. It is concluded that the electron gas in the wave is compressed isothermally. (tr-auth)

10663 PECULIARITIES OF A POWERFUL HIGH-FREQUENCY DISCHARGE IN A FIELD THAT INCREASES TO ITS PERIPHERY. Andrianov, A. M.; Levadnyi, G. B.; Osovets, S. M.; Sinitsyn, V. I. Zh. Tekh. Fiz., 38: 1641-52(Oct. 1968). (In Russian).

High-frequency discharges in cylindrical and spherical geometry were investigated. High-speed photography was used in the analysis, along with magnetic probes, for field distribution measurements. For calorimetric measurements a thermal probe was used. It was shown that the complex structure discharge, in the process of stepwise compression, is localized in space. (tr-auth)

10664 MEASUREMENT: AS A FUNCTION OF PRESSURE, OF THE VARIATION OF THE ELECTRON–ION RECOMBINATION COEFFICIENT IN WEAKLY IONIZED HELIUM IN RELAXATION REGIME. Deloche, Robert; Gonfalone, Alain; Cheret, Michel (Service de Physique des Interactions Electroniques, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 267: 934-7(Oct. 28, 1968). (In French).

The variation of the electron–He_2^+ ion recombination coefficient was experimentally determined as a function of the pressure and electron density. The coefficients, stabilized respectively by an electron and by a neutral particle, were determined at room temperature. (tr-auth)

10665 DIFFUSION OF LASER LIGHT BY A LABORATORY PLASMA. Baconnet, J. P.; Cesari, G.; Coudeville, A.; Watteau, J. P. Bull. Inform. Sci. Tech. (Paris), No. 130, 37-52(Oct. 1968). (In French).

The theory of the electromagnetic-wave scattering by a plasma has originated from the understanding of the radar scattering by the ionosphere. When λ is of the order or greater than the Debye length the so-called cooperative scattering partially comes from the slow electrons which follow the ionic fluctuations. The 90°

cooperative scattering of the light of a ruby laser by the cold and dense plasma of an electrical discharge was studied. (auth)

10666 HELICON WAVES IN A NON-UNIFORM PLASMA. Blevin, H. A.; Christiansen, P. J. (Flinders Univ. of South Australia). Plasma Phys., 10: 799-801(Aug. 1968).

It is shown that an analytical expression for the dispersion of helicon waves can be found when the electron density has a particular radial variation and only axially symmetric modes of oscillation are considered. (UK)

10667 TRANSMISSION MEASUREMENTS OF ELECTROSTATIC PLASMA WAVES IN THE GHz FREQUENCY RANGE. Tutter, M. (Institut fuer Plasmaphysik, Munich). Plasma Phys., 10: 775-85(Aug. 1968).

In the positive column of an argon low-pressure gas discharge waves in the GHz range were transmitted parallel and perpendicularly to the tube axis between two probes. These waves were identified as electrostatic waves by means of their dispersion relation. (auth) (UK)

10668 ROTATIONAL MOTION OF MAGNETIZED PLASMAS. Witalis, E. A. (Research Inst. of National Defence, Stockholm). Plasma Phys., 10: 747-52(Aug. 1968).

A general relation is derived for the velocity vorticity dependence on the fields and forces present in a magnetized plasma. It is shown that time and, for a moving plasma, space variations of the magnetic field will lead to rotation if the plasma has the usual tensor conductivity, i.e., exhibits Hall effect. (auth) (UK)

10669 DISTRIBUTION OF EMISSION INTENSITY NEAR ELECTRON CYCLOTRON HARMONIC FREQUENCIES. Shimomura, Noboru; Mitani, Kenji (Kyoto Univ.). Kakuyugo-Kenkyu, 22: No. 2, 91-8(Jan. 1969). (In Japanese).

The emission from a plasma in a uniform magnetic field is studied near electron cyclotron harmonic frequencies. Following the dressed test-particle approach, the energy lost by one test electron is calculated and, from this, the total emission is given as the sum over all electrons weighted by their velocity distribution by the superposition principle of the dressed test particles. In general, dispersion relation for the electrostatic wave propagating to the direction nearly perpendicular to the magnetic field has two solutions, comprising a slow electrostatic wave and a fast electrostatic wave. It is found in the Allis diagram that the emission peaks for these waves shift from the lower harmonic side to the higher side with a considerably different way to each other. The emission power of the slow wave is much greater than that of the fast wave, because the number of the electrons which contribute to excitation of the slow wave is large and also the thermal velocity/phase velocity ratio is large. (NSA of Japan)

10670 COMPUTATION OF THE PLASMA DISPERSION FUNCTION. Franklin, R. N. (Oxford Univ.). Plasma Phys., 10: 805-8(Aug. 1968).

Results are presented of new calculations for the dispersion relation for plasma waves at low phase velocity, and a table of coefficients of rational function approximation is given. (UK)

10671 BREAKDOWN OF GASES IN A HIGH-FREQUENCY ELECTRIC FIELD WITH AND WITHOUT A STEADY TRANSVERSE MAGNETIC FIELD. Sen, S. N.; Bhattacherjee, B. (North Bengal Univ., Darjeeling, India). J. Phys. A (London), 2: 106-15(Jan. 1969).

Breakdown of gases at a pressure of 1.5 mtorr under the action of a high-frequency uniform electric field was studied in tubes of length 5, 7, and 15 cm and 3.5 cm diameter, as well as with a superimposed steady transverse magnetic field of 18 to 45 gauss in tube of length 5 cm. It was found that the breakdown voltage increased as the length was decreased. The cutoff wavelength increased with the tube length. The breakdown is here due to secondary electron resonance. The phase angle ϕ and the maximum kinetic energy of the electron hitting the wall were calculated and found to agree with earlier results. In the presence of a magnetic field the breakdown voltage, as well as the cutoff wavelength, increased with rising magnetic field. The corresponding theory is developed and the effect of the angle on arrival at the end wall on the breakdown mechanism is considered. Comparisons of the observations with the theory yield values of the phase angle and of the electron's kinetic energy on arrival at the wall with a fair amount of accuracy, especially for magnetic fields smaller than 30 gauss. The probability of electrons colliding with the side walls is considered. Under the experimental setup, the majority of electrons with energy sufficient to cause breakdown travelled freely between the two ends of the tube. The validity of some of the simplifying assumptions made in the theory is discussed. (auth) (UK)

10672 EFFECT OF NONLINEAR EXCITATION ON MAGNETO-ACOUSTIC RESONANCE IN A COLD PLASMA. Faessler, K.; Vaclavik, J.; Schneider, H. (Univ. of Fribourg, Switzerland). Helv. Phys. Acta, 42: 23-45(Feb. 15, 1969).

In magnetoacoustic resonance, amplification of the exciting magnetic field was studied, both theoretically and experimentally, in the region where B_z is not small compared with magnetostatic field B_0. Dependence on the mutual polarity of B_0, B_z, and on the exciting energy was found and excitation of higher harmonics was observed. (auth)

Production

Refer also to abstract 10606.

10673 (SC-T-68-1541) DISSIPATION OF A HEATED MASS OF GAS IN A REGULAR REGIME. Nemchinov, I. V. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 18-29(1964). 24p. Dep. CFSTI.

An examination is made of the movement of a given gaseous mass, the molecules of which release energy, whereby the intensity of the energy release depends on the temperature and density in an exponential way, while the dependence on time is arbitrary. An analysis is made of the analog of the solution found by L. I. Sedov concerning the problem of the adiabatic dissipation being an auto-model solution describing the movement of the gas when heated in a regular regime; furthermore, the character of the distribution of parameters is studied according to the gas molecules and in relation to time in the presence of different power exponents comprised by the law of heat emission. Finally, the question pertaining to the establishment of an auto-model solution is discussed in conjunction with its applicability to certain concrete processes of gas-dynamic movement when intense heat is used. (auth)

10674 ARGON HEATING DC PLASMATRON WITH POTASSIUM AS ADDITIONAL AGENT. Ivanov, E. F.; Nikolaev, G. N. (Inst. of High Temperatures, Moscow). Teplofiz. Vys. Temp., 6: 1142-4(1968). (In Russian).

Descriptions are given of the design and performance of a plasmatron in which an additional agent was introduced into the arc chamber by potassium evaporation in a preliminary heated argon jet. The plasmatron operated as a pinch discharge producing 1500 to 2500°K plasma (while under diffusion conditions the plasma temperature was below 1000°K). The plasmatron continuous operation time was 50 hr. The designed plasmatron produced an argon plasma jet with additional potassium jet at pressures close to atmospheric and temperature from 1500 to 2000°K with a gas consumption ranging from 0.2 to 2.5 g/sec and potassium consumption from 0.004 to 0.05 g/sec. (R.V.J.)

10675 THE PRODUCTION AND LOSS OF N_2^+ IONS IN THE NITROGEN AFTERGLOW. Lund, R. E.; Oskam, H. J. (Univ. of Minnesota, Minneapolis). Contract AF 19(628)-4794. Z. Phys., 219: 131-46(1969).

The time dependence of the number density of nitrogen ions was studied in the pressure range of about 0.1 to 1.7 torr by means of mass-spectrometric probing of decaying nitrogen plasmas. The analysis of the N_2^+ decay curves showed that N_2^+ ions are produced in the afterglow by collisions between metastable nitrogen molecules. Energy level and radiative lifetime considerations indicate that one of the metastable molecules is in the $\alpha'\ ^1\Sigma_u^-$ state, while the other metastable molecule may be in the same state or in the $A\ ^3\Sigma_u^+$ or $^3\Delta_u$ state. The surface catalytic efficiency for de-excitation of the metastable molecules involved upon striking the molybdenum-covered plasma container walls was estimated to be smaller than 2×10^{-3} at a pressure of 0.09 torr. If both interacting metastable molecules are in the $\alpha'\ ^1\Sigma_u^-$ state, the measurements result in the value of 1.3×10^{-18} cm^2 for the cross section for destruction of this state by collisions with ground-state nitrogen molecules. (auth)

10676 INVESTIGATION OF CONDENSED PRODUCTS OF A LASER-PRODUCED PLASMA USING THE METHOD OF INFRARED SPECTROSCOPY. Akhmanova, M. V.; Kaigorodov, V. A.; Karyakin, A. V. Zh. Prikl. Spektrosk., 8: 858-60(1968). (In Russian).

Production and composition of the condensation products obtained in the interaction of a laser beam with silicon and carbon minerals and with some inorganic crystals has been studies. A 20-Joule laser was used in the production of the condensates which were deposited on infrared-transparent materials. The condensates were produced at atmospheric pressure and existed for 0.8 to 1.2×10^{-4} sec. The collecting surfaces received the

still incandescent materials which had velocity of 200 m/sec. The spectral properties of these condensates were compared with the infrared properties of the same materials in pulverized form. The differences are described and a general conclusion is made that at normal pressure, metals tend to oxidize but in the case of nonmetals (and partly in the case of silicates), complex molecular structures are broken down to simpler forms. The data in the infrared range, compiled in this work, together with data in the ultraviolet and visible regions, are useful in the formulation of physical models for explosive processes on the surface of solids. (ATD)

10677 THE CHEMICAL RATE EQUATION FOR A MAGNETOACTIVE PLASMA IN REACTIVE NONEQUILIBRIUM. Olivei, A. (Direzione Progetti Speciali, Olivetti, Italy). Z. Phys., 219: 147-61(1969).

A statistical theory of the ionization for magnetoactive plasma having a nonequilibrium concentration level and a nonequilibrium energy distribution is given taking in account the nonequilibrium collisioaal and radiative processes. The derived chemical rate equation can be employed in the presence of transient superthermal inductions even at high plasma temperature. Under a given number of conditions the ionization may be enhanced or depressed as in the case of reactive equilibrium of magnetoactive plasma. (auth)

10678 PRODUCTION AND INVESTIGATION OF INHOMOGENEOUS PLASMA IN PENNING DISCHARGES. Kreindel, Yu. E.; Levshuk, L. A. Zh. Tekh. Fiz., 38: 1675-83(Oct. 1968). (In Russian).

The effect of local deformation of the magnetic field in a Penning tube with rectangular anode on the discharge characteristics and near-anode parameters of plasmas was studied. It was found that the nature of the effect of deformation of the field depends on the discharge regime in the tube. It was shown that due to deformation, irregularity of anode current density will be increased, and electron temperature at the anode decreased. (tr-auth)

10679 INTERACTION WITH MATTER OF A VERY STRONG LASER BEAM. Bobin, J. L. Bull. Inform. Sci. Tech. (Paris), No. 130, 3-12(Oct. 1968). (In French).

Theoretical considerations about the heating up of a deuterium plasma by a powerful focused laser beam lead to the following conclusions: the initial laser energy must be as high as possible; and this energy must be delivered to the plasma within the shortest time interval. Experiments performed with deuterium and beryllium plasma produced with 30-ns focused laser pulses show the harmful effect of a too-fast expansion. (auth)

10680 PLASMA CREATION BY THE USE OF LASER PULSES OF FAST RISING WAVE SURFACE (1 ns). Langer, P.; Floux, F.; Guyot, D.; Reuss, J. Bull. Inform. Sci. Tech. (Paris), No. 130, 13-18(Oct. 1968). (In French).

In a series of experiments the beam of a Q-switched laser ($\lambda = 1.06\ \mu m$) delivering ultra-short pulses ($\Delta t = 4$ ns) is focused either in gases (air and deuterium) or inside a transparent solid (lucite). The evidence for a breakdown wave, as predicted by the theory, is shown. The phase velocity of this wave reaches 10^8 $cm.s^{-1}$ in S.T.P. deuterium. To obtain a high temperature dense plasma the initiation of this breakdown wave must be avoided, and the regime in which an optical detonation occurs must be retained. This regime can be developed during the interaction with ultra-short steep rising pulse (10^{-10} s) now obtainable by amplification of picosecond laser pulses. (auth)

10681 HIGH-TEMPERATURE PLASMAS PRODUCED BY EXPLODING WIRES. Ross, David P.; Zinke, O. H. (Univ. of Arkansas, Fayetteville). pp 147-60 of Exploding Wires. Vol. 4. Chace, William G.; Moore, Howard K. (eds.). New York, Plenum Press, 1968.

From 4th Conference on the Exploding Wire Phenomenon, Boston. See CONF-671044.

The time-of-flight technique for the analysis of transient plasmas discussed at the previous Exploding Wire Conference by Zinke, Owen, and Manka has been perfected to include a flow velocity, and the "containment time" is now interpreted as a "plasma release time." Plasmas have been generated from gold wires which have temperatures of 2×10^5 K, densities of 10^{18} cm^{-3}, and flow velocities of about 3×10^6 cm/sec. The critically damped discharge current is "slow" by Bennett's criterion, and analyses of the current, voltage, and light data indicate heating by a collapsing pinch effect at the current maximum of a plasma produced through gaseous breakdown in vapor generated by Bennett's expansion wave. The plasma is apparently stabilized from electromagnetic ejection by a liquid core. Flow velocities do not seem to be electromagnetic in origin. Wedemeyer's objections to the time-of-flight technique are discussed. (auth)

10682 EXPLODING WIRES. VOLUME 4. Proceedings of the Fourth Conference on the Exploding Wire Phenomenon, held at Boston, October 18–20, 1967. Chace, William G.; Moore, Howard K. (eds.). New York, Plenum Press, 1968. 354p. $17.50. (CONF-671044).

Twenty-six papers are included; separate abstracts were prepared for the two in scope for NSA. The relation of shock waves and exploding wires, applications (particularly as exploding bridge wires), chemical reactions induced by wire explosions, and the general theory of the wire explosion are covered. The resistivity-density relation in wire explosions, and the use of lasers and x-rays for the study of exploding wires are included. (M.H.R.)

For abstracts of individual papers see: 10622 and 10681.

Stability

Refer also to abstract 10632.

10683 (COO–1695-14) PLASMA INSTABILITIES AND WAVES EXCITED BY AN ANISOTROPIC ENERGY DISTRIBUTION PRODUCED BY ELECTRON CYCLOTRON RESONANCE. Annual Progress Report, December 15, 1967–December 14, 1968. Shohet, J. L. (Wisconsin Univ., Madison. Dept. of Electrical Engineering). Dec. 15, 1968. Contract AT(11-1)-1695. 66p. Dep. CFSTI.

A study was made to investigate the ability of a short pulse of electron cyclotron resonance radiation to produce an anisotropic energy distribution of electrons in a plasma, and the instabilities and waves produced by this anisotropy. In particular, the nature of the rf heating mechanism and the behavior of the radiation emitted from the plasma were considered. The electron cyclotron resonance device shown was operated to obtain measurements of free–free bremsstrahlung, wall bremsstrahlung, plasma diamagnetism, energetic electron flux, and electron density in the discharge. A brush cathode gun was constructed and operated as a PIG discharge in the vacuum chamber. An aluminized scintillator and microwave interferometer were constructed and placed in the vacuum chamber to measure axial and radial particle flux. A signal averaging device was constructed and tested. An instability in the operation of the device was observed. This was characterized by rapid ejection of particles and radio frequency emission. The instability was observed as the mirror ratio was changed. Theoretical work is under way to determine the nature of this instability as well as a new method for evaluating the eigenfrequencies of a microwave cavity filled with a plasma of variable density. Relativistic x-ray bremsstrahlung theory was expanded. (auth)

10684 DRIFT INSTABILITY OF A PLASMA WITH CHARGED IMPURITIES. Silin, V. P. (Lebedev Inst. of Physics, Moscow). Zh. Tekh. Fiz., 38: 945-55(June 1968). (In Russian).

The drift-cyclotron instability is analyzed for a low-β machine which contains charged impurities. The method of geometrical optics is used to determine the stability criterion for the buildup of oscillations in the plasma with charged impurities either trapped in the field or penetrating through it. The oscillation buildup is found to be at frequencies in multiples of the gyroscopic frequency of the heavy ions. A consideration is also given for instabilities where the frequency and increment γ are substantially less than the gyroscopic frequency of the heavy ions. (TSS) (ATD)

10685 KINETIC THEORY OF THE DIOCHOTRON INSTABILITY. Nocentini, A.; Berk, H. L.; Sudan, R. N. (Univ. of California, Livermore). J. Plasma Phys., 2: 311-27(1968). (UCRL-70807).

The diochotron instability of a thin, tenuous, cylindrical layer of charged particles, whose gyro-radius is of the order of the mean radius of the cylindrical layer, is investigated using the Vlasov equation. Two distribution functions are considered which give practically the same density in the physical space, but are quite different in the velocity space: in the first the velocity spread is practically zero; in the second the particles oscillate around the mean radius of the cylindrical layer. It is shown that the first distribution exhibits the usual diochotron instability, while the second one does not. It is also shown that, however small the velocity spread, the thickness of the cylindrical layer cannot go to zero. Its minimum value is roughly determined by equating the plasma frequency to the cyclotron frequency. (auth)

10686 OBSERVATION OF RAYLEIGH–TAYLOR INSTABILITIES. Stuart, K.; Levi, E. (Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.). J. Appl. Phys., 40: 441-2(Jan. 1969).

Observations were made on a pulsed toroidal discharge. The toroidal structure has a rectangular cross section and utilizes inductive coupling to transfer energy from the current pulse in the primary winding to the plasma. An S.T.L. image-converter camera was used to obtain high-speed streak and framing photos of the plasma motion in the radial direction. (M.O.W.)

10687 INVESTIGATION OF STABILITY OF PLASMA WITH ANISOTROPIC PRESSURE USING QUASI-HYDRODYNAMIC APPROXIMATION. Yashin, V. I. Zh. Tekh. Fiz., 38: 1613-18 (Oct. 1968). (In Russian).

Based on the energy principle in the Chew–Goldberger–Low approximation, the stability of plasma with anisotropic pressure in axially symmetric magnetic fields was studied. The applicability of the quasi-hydrodynamic equation, which form the basis of the energy principle, is shown in this case to be limited. The generalization of the Newcomb theorem on plasma jets with anisotropic pressure was performed. (tr-auth)

10688 QUASI-NEUTRAL SCREW INSTABILITY OF A POSITIVE COLUMN. Imazu, Shingo (Niigata Univ., Japan); Sato, Hiroshi. Kakuyugo-Kenkyu, 22: No. 2, 56-66(Jan. 1969). (In Japanese).

A screw instability in a positive column is investigated theoretically, under the assumptions that the densities of the electrons and ions are perturbed independently, and that the perturbed densities have finite amplitude. Under these restrictions, an evaluation of the steady-state densities is derived by applying Volterra's integral equation. These theoretical assumptions are confirmed by measurements, and the theoretical values of the steady-state density are in good agreement with experimental results. (NSA of Japan)

10689 NEGATIVE ABSORPTION DUE TO COLLISIONS IN A DRIFTED ELECTRON PLASMA. Stenflo, L. (Univ. of Uppsala). Plasma Phys., 10: 801-3(Aug. 1968).

It is shown that collision-induced instabilities cannot be caused by a strong anisotropy in velocity-space in a current-carrying electron plasma. The runaway phenomenon is responsible for this conclusion, which is opposite to that of other authors. (auth) (UK)

10690 INTERCHANGE INSTABILITIES IN IDEAL HYDROMAGNETIC THEORY. Greene, J. M.; Johnson, J. L. (Princeton Univ., N. J.). Plasma Phys., 10: 729-45(Aug. 1968).

Interchange instabilities are examined using an ideal hydromagnetic model. The nature of the energy sources that can drive the instability is clarified. (auth) (UK)

10691 ANISOTROPIC INSTABILITY IN A HOT ELECTRON PLASMA, CONTAINED IN AN ADIABATIC TRAP. Alikaev, V. V.; Glagolev, V. M.; Morozov, S. A. (Kurchatov Inst. of Atomic Energy, Moscow). Plasma Phys., 10: 753-74(Aug. 1968).

An investigation was made of the behavior of a plasma with hot electrons obtained by electron cyclotron resonance heating in an adiabatic trap. An instability was observed which led to rapid loss of the energy of transverse plasma motion in a time ~1 μsec. The instability was accompanied by radiation near the electron cyclotron frequency and its second harmonic. Simultaneously, the ejection of hot electrons was observed, both along and perpendicular to the magnetic lines of force. A possible theoretical explanation of the observed phenomena is considered. (auth) (UK)

Thermonuclear Processes

Refer also to abstract 10929.

Shielding

Refer also to abstract 10889.

10692 (ORNL-tr-2033) ATTENUATION FACTORS FOR BROAD BEAM GAMMA RADIATION IN LEAD, STEEL, CONCRETE, AND WATER. Hoenig, Arnost. Translated for Oak Ridge National Lab., Tenn., from Inzenyrske Stavby, No. 3, 117-30(1968). 22p. Dep. CFSTI.

Methods, tables, and graphs for the determination of the dimensions of shielding thickness of basic construction material such as lead, steel, concrete, and water are presented. The entire calculation is limited to determining the exposure rate of a bare, unshielded emitter and determination of the necessary attenuation ratio I/I_0. (M.H.R.)

10693 (ORNL-tr-2044) ARTUS PROGRAM: CALCULATION OF THE QUANTITIES OF ENERGY RELEASED BY NEUTRONS IN A SOLID. Barre, Bertrand (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report CEA-Note-N-827. 36p. Dep. CFSTI.

The programs described were formulated on the occasion of a special study relative to the influence of the ionization of CO_2 by neutrons on the reaction CO_2–graphite. They are described from the standpoint of this study. It is shown that they can be used for the solution of a group of much more general problems. (M.H.R.)

10694 (ORNL-tr-2045) VARIANT OF THE ZEUS PROGRAM APPLIED TO TUNNEL PROGRAMS: ZEUS ALB.5 PROGRAM AND AUXILIARY PROGRAMS. Gervaise, Francois; d'Hombres, Marguerite-Marie (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report CEA-Note-N-933. 44p. Dep. CFSTI.

In the course of a study of the propagation of very fast neutrons in the tunnels of a synchrotron, it was necessary to adapt the current ZEUS 4 program for reactor shielding research so as to obtain computing results in a reasonable time. Auxiliary programs and a special version of the main program were constructed. These are ZEUS ALB.5, AVARIE 5, MAGGY 5, and LEONIE 5. After a brief review of the principles of the ZEUS 4 program, an analysis of the difficulties encountered as well as the remedies applied, and the detailed method of application of each of the programs are presented. They can be directly used for other problems of fast neutron leakages in slits or pipes of large sizes. (M.H.R.)

10695 (SC-RR-68-712) DTFALL: A PROGRAM TO RUN PHOTON TRANSPORT PROBLEMS BY THE METHOD OF DISCRETE ORDINATES. Adams, K. G. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1968. 24p. Dep. CFSTI.

A computer program is presented which combines into one program all procedures necessary to run a photon-transport calculation with the use of the discrete ordinate method. Required inputs to run such a calculation have been simplified and minimized, and the described program is available upon request. (auth)

10696 (UCRL-50400(Vol.6)) AN INTEGRATED SYSTEM FOR PRODUCTION OF NEUTRONICS AND PHOTONICS CALCULATIONAL CONSTANTS. VOLUME VI. PHOTON CROSS SECTIONS 1 keV TO 100 MeV. Plechaty, Ernest F.; Terrall, John R. (California Univ., Livermore. Lawrence Radiation Lab.). Oct. 22, 1968. 191p. Dep. CFSTI.

Photon cross sections from 1-keV to 100-MeV photon energy are tabulated for 87 elements ($Z \leq 94$). (auth)

10697 THE ATTENUATION OF 14 MeV NEUTRONS IN STEEL AND POLYETHYLENE. Greene, D.; Thomas, R. L. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Phys. Med. Biol., 45-54(Jan. 1969).

The attenuation of broad beams of 14-MeV neutrons in steel and polyethylene, and in combinations of these two materials, was studied. It is shown that while steel is the better material for attenuating the primary neutrons, it is advantageous to add polyethylene to attenuate slowed-down neutrons scattered from the steel, followed by a further layer of steel to remove photons generated in the polyethylene. Data are given for the radiation components emerging from shields using various combinations of these materials. (auth) (UK)

Solid-State Physics

Refer also to abstracts 9450, 9462, 9715, 9735, 9799, 9800, 9801, 9803, 9824, 10203, 10248, 10572, 10920, 10921, 10927, 10970, and 11008.

10698 (CEA-Bib-127) NUCLEAR MAGNETIC RESONANCE AND MOLECULAR MOTIONS IN SOLIDS. Chachaty, Claude (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1968. 34p. (In French). Dep.

How nuclear magnetic resonance NMR may be used to study the structure and molecular motions of solids is shown. Evidence of these motions is given by measurements of width and second moment of spectra and also by the spin-lattice relaxation time. Some examples are given of the application of NMR to the study of organic solids, chosen particularly among globular compounds, clathrates and large linear molecules. (auth)

10699 (CEA-CONF-1045) DEGRAPHITIZATION UNDER THE EFFECT OF NEUTRON IRRADIATION. Micaud, G.; Rappeneau, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Pacault, A.; Marchand, A. (Bor-

deaux Univ., Pessac (France). Institut de Magneto-Chimie). [1968]. 40p. (In French). (CONF-680620-3). Dep.

From 18th Annual Meeting on Carbonization and Graphitization, Paris, France.

In order to study the effects of neutron radiation on the electrical and magnetic properties of a polycrystalline nuclear graphite, samples were irradiated at doses increasing to 8.5×10^{21} neutrons/cm^2 and at four different temperatures: 85, 150, 200, and 280°C. The electrical resistivity, Hall effect, magnetoresistance, magnetic susceptibility, and electronic paramagnetic resonance of these samples were measured at 300°K in order to study the variation of these properties as a function of dose and at different temperatures. Certain of these samples, irradiated under quite different dose and temperature conditions, were heat-treated and examined in the course of annealing. The analogy between the curves thus obtained and those plotted during graphitization of the same material suggests that the effect of neutron radiations may resemble a "degraphitization" process. (auth)

10700 (CEA-R-3495) MAGNETIC STUDY OF A FEW ANTIFERROMAGNETS IN VERY-STRONG PULSED FIELDS (450 kOE). Krebs, Jean-Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1968. 166p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Orsay, France.

A pulsed-field device is described with which magnetization curves up to 450 kOe at all temperatures between 1.6°K and 300°K were obtained. The "spin-flipping" (and therefore the anisotropy) in MnF_2 versus temperature, below the Neel point, was studied. The antiferromagnets $MnSO_4$ and $MnSO_4 \cdot H_2O$ which have revealed saturation fields respectively of 250 kOe and 320 kOe, were also studied. (auth)

10701 (CONF-680819-(Vols.1 and 2)) 3. NORDIC SOLID STATE CONFERENCE, AUGUST 12-17, 1968, COPENHAGEN DENMARK. VOL. 1. ABSTRACTS OF PAPERS. VOL. 2. REPORT ON THE ACTIVITIES OF NORDIC RESEARCH GROUPS IN THE FIELD OF SOLID STATE PHYSICS. (Nordisk Institut for Teoretisk Atomfysik, Copenhagen (Denmark)). 156p.

Issued in two volumes, but cataloged as a unit.

Abstracts of 94 papers presented at the subject conference (Vol. 1) are included. Of the papers in scope, some have already appeared in NSA; others will appear later. The abstracts are grouped here under the following Session headings: Magnetism, Lattice Structures and Vibrations, Lattice Imperfections, Superconductivity and Many-Body Theory, Surfaces, High Field Instabilities, Transport Properties, Optical Properties, Band Structure and Fermi Surfaces, and Interactions between Solids and Energetic Ions. Basic research activities in Denmark, Finland, Norway, and Sweden in the fields of solid-state physics and metallurgy are briefly outlined in Vol. 2. (TSS)

10702 (UCRL-Trans-10259) LUMINESCENCE OF TRACE RARE-EARTHS INTRODUCED INTO Y_2O_2S. Ozawa, R. Translated by M. Tanaka for Univ. of California Lawrence Radiation Lab., Livermore, from Oyo Butsuri, 37: 80-4(1968). 17p. Dep. CFSTI.

The fluorescent characteristics of Y_2O_2S crystals doped with traces of rare earths were investigated in the uv and visible regions, with emphasis on the green fluorescence. The doping ions studied included Pr^{3+}, Eu^{3+}, Tb^{3+}, Er^{3+}, and Tm^{3+}. The fluorescence was influenced by the Tb^{3+} present as impurity. (D.L.C.)

10703 (WAPD-Trans-100) INVESTIGATION OF THE ACTIVE CRYSTAL LENGTH IN THE YIELD REGION OF NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. 2. THE ACTIVE CRYSTAL LENGTH. Neuhaeuser, H. Translated from Phys. Status Solidi, 27: 281-90(1968). 21p. Dep. CFSTI.

The active crystal length measured by a cinematographic method in the yield region of neutron-irradiated copper single crystals at various deformation rates (cross-head speeds $\dot{l} = 2 \times 10^{-2}$ to 4×10^{-2} mm/sec), temperatures (90 to 360°K), and irradiation doses (5×10^{17} to 7×10^{18} n/cm^2) varies from $l_a = 20$ to 2,000 Å. At a fixed dose and a fixed temperature, the active crystal length increases with the strain rate $\dot{\varepsilon}$ and the deformation rate $\dot{l}$ is observed for $\dot{l} \gtrsim 10^{-4}$ mm/sec. At a fixed deformation rate $\dot{l}$, the strain rate $\dot{\varepsilon}$ varies with the temperature as well as with the dose; l_a decreases with increasing temperature and increasing dose. The dependencies are discussed qualitatively. (auth)

10704 CATHODOLUMINESCENT PROPERTIES OF THE RARE EARTHS IN YTTRIUM OXIDE. Buchanan, R. A.; Wickersheim, K. A.; Weaver, J. L.; Anderson, E. E. (Lockheed Palo Alto Research Lab., Calif.). J. Appl. Phys., 39: 4342-7(Aug. 1968).

The cathodoluminescent properties of eleven trivalent rare earths in yttrium oxide (Y_2O_3) have been studied. Total intensities and selected line intensities were measured as a function of activator concentration. Emission spectra from 2000 to 30,000 Å, decay times, and energy efficiency are reported. (auth)

10705 THEORIE DU MAGNETISME. (Theory of Magnetism). Herpin, Andre. Bibliotheque des Sciences et Techniques Nucleaires. Saclay, France, Institut National des Sciences et Techniques Nucleaires, 1968. Paris, Presses Universitaires de France, 1968. 902p.

The material is presented under the following chapters: generalities, generalities on the theory of magnetism, experimental methods for the study of magnetism, paramagnetism of free atoms, the crystalline field, thermodynamics and magnetism, exchange interactions, ferromagnetism in the molecular field approximation, magnetization fluctuations in the vicinity of the transition point, magnetic anisotropy, dynamics of the magnetic moment, superexchange, antiferromagnetism in the molecular field approximation, helimagnetism, weak ferromagnetism, spin waves in the antiferro- and the ferromagnetics-antiferromagnetic resonance, antiferromagnetic structures, ferromagnetism, the ferromagnetic spinels, the ferromagnetic garnets, the Weiss domains, fine-grain magnetic properties, the hysteresis cycle, and the magnetic coupling hysteresis effect. (M.H.R.)

10706 PRODUCTION AND ANNEALING OF INTRINSIC DEFECTS IN X-RAY-IRRADIATED CADMIUM SULFIDE. O'Connell, Joseph Charles. Newark, Del., Univ. of Delaware, 1967. 76p.

Thesis.

"Pure" CdS single crystal platelets were exposed to x rays of up to 300 keV at room temperature and liquid nitrogen temperature. Spectral distribution of photo current and thermally stimulated current measurements were made in ultra-high vacuum ($\sim 10^{-10}$ torr) before and after irradiation and after annealing above room temperature. A model is proposed to explain the observed changes in these measurements based on displacement in the sulfur sublattice. An electron trapping level at $E_c - E_t = 0.5$ eV is identified as due to sulfur vacancies. In addition a recombination center is produced by sulfur vacancies diffusing to other defects to form associates. The damage produced anneals to a large extent after a heat treatment at 150°C. Further information is obtained from x-ray damage of crystals pre-heat treated in cadmium or sulfur vapor to shift the stoichiometry. (Diss. Abstr.)

10707 INTERPRETATION OF THE PERIODICITY IN ENERGY LOSS OF A WELL-CHANNELED ION WITH RESPECT TO ITS NUCLEAR CHARGE. Harrison, Don E. Jr. (Sandia Labs., Albuquerque, N. Mex.). Appl. Phys. Lett., 13: 277-9(Oct. 15, 1968).

The Z_1 periodicity in the inelastic energy loss cross section is shown to be contained in the electron density of the moving ions when that density is determined from Hartree-Fock-Slater wave functions. (auth)

10708 DYNAMIC RESPONSE OF SOLIDS EXPOSED TO A PULSED-ELECTRON-BEAM. Oswald, R. B. Jr.; Schallhorn, D. R.; Eisen, H. A.; McLean, F. B. (Harry Diamond Labs., Washington, D. C.). Appl. Phys. Lett., 13: 279-81(Oct. 15, 1968).

The first measurements of free surface displacement and velocity induced by the absorption of a pulse of electrons in a solid are reported. The laser-interferometric measurements demonstrate that the dynamic response of materials induced by charged-particle interaction can be observed in detail. (auth)

10709 IRRADIATION FAULTS IN α URANIUM AND THE MATTHIESSEN RULE. Jousset, J. C. (Renssaelaer Polytechnic Inst., Troy, N. C.). Phys. Status Solidi, 29: K127-31 (1968). (In French).

The variation of the electric resistivity with temperature was observed for a sample of uranium irradiated with thermal neutrons at a dose of 2×10^{17} thermal neutrons/cm^2 and compared with a sample without faults. The study was made at 4.2 and 77°K. The variation of R with T is considerable. The values are $\Delta\alpha$ (4.2°K) = 2770×10^{-10} Ωcm and $\Delta\alpha$ (40°K) = 780×10^{-10} Ωcm. Two possible interpretations are given for this deviation from the Matthiessen rule. The faults are more resistant in the α_0 phase at low temperatures (T < 43°K) and there is a magnetic order transformation at low temperatures. (J.S.R.)

10710 CRITICAL ANGLES FOR CHANNELING OF LOW-ENERGY IONS IN TUNGSTEN. Bergstroem, I. (Research Inst. for Physics, Stockholm); Bjoerkqvist, K.; Domeij, B.; Fladda, G.; Andersen, S. Can. J. Phys., 46: 2679-82(Dec. 1, 1968).

The critical angle ψ for channeling of light and heavy ions in crystals has been studied around the ⟨111⟩ direction in a tungsten single crystal by measuring the yield of backscattered ions at

room temperature. The ions and their energies E were chosen such that the critical angle was comparable to, or larger than, the ratio between the screening radius a and the atom spacing along the string d. According to Lindhard $\psi = \psi_1 \sim (E/Z_1)^{-\frac{1}{3}}$ for $\psi < a/d$ and $\psi = \psi_2 \sim (E/Z_1)^{-\frac{1}{2}}$ for $\psi > a/d$. The variation of the critical angle with E/Z_1 was studied for the ions ^1H, ^2H, ^4He, ^{12}C, ^{20}Ne, ^{40}Ar, and ^{84}Kr in the critical angle region $4a/d > \psi > a/d$. For ^{12}C, ^{20}Ne, ^{40}Ar, and ^{84}Kr, most of the data are in the transition region between ψ_1 and ψ_2, but an approach to the ψ_2 behavior can be seen at the low energy end. For ^1H, ^2H, and ^4He, however, the energy dependence is rather of the ψ_1-type for the whole region studied, that is even for critical angles as large as $\psi = 4a/d$. The value of the multiplicative constant C_2 is also different for the two cases, being close to 1 for the heavy ions but about 2 or larger for the light ions. (auth)

10711 DISLOCATION RELAXATION IN TANTALUM AT LOW TEMPERATURES. Verdini, L.; Vienneau, L. A. (Univ. of Alberta, Edmonton). Can. J. Phys., 46: 2715-17(Dec. 1, 1968).

A maximum in the dissipation vs. temperature curve has been observed at about 25°K in tantalum after a permanent deformation of about 7%. The temperature of the maximum increases with the vibration frequency indicating the presence of a thermally activated relaxation process. This effect is attributed to the dislocation motion (Bordoni peak) and the characteristic parameters are $\overline{W} = 0.038$ eV and $\overline{\tau}_0 = 1.2 \times 10^{-13}$ s. Using the Seeger equation, a value for the Peierls' stress of about 6.5×10^6 dyn cm^{-2} is found. The presence of a large spectrum of relaxation times is also discussed. (auth)

10712 AB INITIO CALCULATION OF PHONON DISPERSION CURVES FOR BERYLLIUM. Koppel, Juan Ulrico. San Diego, Calif., Univ. of California, 1968. 178p.

Thesis.

Sham's method for calculating phonon dispersion curves in metals is generalized to nonprimitive lattices and applied to the case of beryllium which has the hcp structure. Three effects contribute to the elements of the dynamical matrix which determines the phonon frequencies: (1) the direct Coulomb interaction between ions, (2) the short-range exchange repulsion between core electrons of neighboring ions, and (3) the strong screening action of the conduction electrons. The latter contribution is evaluated from a screened Hartree–Fock expression for the electronic ground-state energy in the distorted crystal. This energy is expanded up to second order in powers of the displacements of the ions from their equilibrium position. The second-order energy involves both the screened and the bare electron–phonon matrix elements which are related to each other by a dielectric screening matrix. This matrix is the essential feature of the method and accounts for the effects of the true band structure of the crystal. Numerical results are given for the beryllium band structure, dielectric matrix, and phonon dispersion curves. Energies and wave functions of the Bloch states are calculated by the orthogonalized plane-waves method. (Diss. Abstr.)

10713 ACCELERATED ELECTRON IRRADIATION EFFECTS ON THE POROUS STRUCTURE OF ALUMOCHROMIUM CATALYST. Dadashev, B. A.; Abbasov, S. G.; Azizov, T. S.; Abdurakhmanova, N. M. Azerb. Khim. Zh., No. 4, 10-12(1968). (In Russian).

Studies were made of the sorption properties of irradiated and nonirradiated alumochromium semiconductors. A specimen of B-25 catalyst (Cr_2O_3-13.6%; Al_2O_3-83.9%; and Cs_2O-2.5%) cooled by running water was irradiated by 5-MeV electrons with flux of 1.2×10^{-4} sec^{-1} for 5 min at a distance of 10 cm from the electron accelerator inlet window. Data obtained showed that the volume and pore radius and the hysteresis area on the isotherm increased considerably in the irradiated B-25 catalyst as compared with the nonirradiated. (R.V.J.)

10714 ELECTRON SPIN RESONANCE ABSORPTION SPECTRUM OF CO_2^- MOLECULE IONS ASSOCIATED WITH F^- IONS IN SINGLE-CRYSTAL CALCITE. Marshall, S. A.; McMillan, J. A. (Argonne National Lab., Ill.). J. Chem. Phys., 49: 4887-90(Dec. 1, 1968).

Single crystals of calcite subjected to γ irradiation exhibit a number of paramagnetic defect centers. One of these has been identified as the CO_2^- molecule ion in close association with an F^- impurity ion. An analysis of the ESR superhyperfine structure due to the fluorine nucleus suggests that for 3.3% of the time, negative charge is transferred from the F^- ion to the CO_2^- molecule ion. This transfer of charge creates the diamagnetic CO_2^{2-} molecule ion and atomic fluorine whose electron configuration is approximately 90% ($2s^22p^5$) and 10% ($2s2p^6$). The effective magnetic field at the fluorine nucleus due to core polarization and 2s contact is calculated to be 21 kOe. (auth)

10715 THRESHOLD ENERGY IN THE ELECTRON BOMBARDMENT CONDUCTIVITY OF DIELECTRIC FILMS. Bowlt, C.; Ehrenberg, W. (London Univ.). J. Phys., C (London), 2: 159-66(Jan. 1969).

Cathode rays induce steady-state conduction in amorphous dielectric films only if their energy exceeds a threshold. A comparison between values for the threshold and theoretical data for the differential dissipation of energy of fast electrons in solids shows that at the threshold the electrons penetrate only half the thickness of the films. The space charge which develops under these conditions and which is made responsible for the occurrence of the threshold was studied by experiments in which both sides of self-supporting films of arsenic trisulfide were exposed to cathode rays. The interpretation of the results is discussed. (auth) (UK)

10716 CRYSTALLINE STRUCTURES OF THE COMPOUNDS NbNiB AND TaNiB. Kuz'ma, Yu. B. (Lvov State Univ.). Sov. Phys.-Cryst. (Engl. Transl.), 13: 597-8(Jan.-Feb. 1969).

Translated from Kristallografiya, 13: 701-3(July-Aug. 1968).

The investigation of a single crystal of NbNiB by the reciprocal lattice photographing method confirmed the orthorhombic symmetry of the Z-phase and lattice parameters values. A more accurate determination of lattice parameters by the powder method gave $a = 3.268 \pm 0.003$, $b = 13.45 \pm 0.005$, and $c = 3.115 \pm 0.003$ Å. The compound TaNiB was investigated by the powder diffraction method. The almost complete agreement between the powder diffraction patterns for TaNiB and NbNiB is proof that the two compounds are isostructural. The lattice parameters of TaNiB have the following values: $a = 3.265 \pm 0.005$, $B = 13.47 \pm 0.01$, and $c = 3.063 \pm 0.005$ Å. (M.H.R.)

10717 THE NATURE OF RADIATION-PRODUCED CITRINE COLORATION IN QUARTZ. Samoilovich, M. I.; Tsinober, L. I.; Kreiskop, V. N. (All-Union Scientific-Research Inst. for the Synthesis of Mineral Raw Materials, Moscow). Sov. Phys.-Cryst. (Engl. Transl.), 13: 626-8(Jan.-Feb. 1969).

Translated from Kristallografiya, 13: 727-30(July-Aug. 1968).

The optical (ultraviolet and visible) and the paramagnetic and infrared (3300 to 3600 cm^{-1}) absorption spectra of a number of radiation-colored natural quartz crystals were measured. The coloration characteristics of specimens before and after irradiation and the results of the spectral analysis for impurity content are tabulated. For comparison analogous data typical of smoky quartz crystals, and of crystals not colored by irradiation were tabulated. (M.H.R.)

10718 TRANSPORT PROPERTIES OF THULIUM SINGLE CRYSTALS. Edwards, L. Roger; Legvold, Sam (Ames Lab., Iowa). Phys. Rev., 176: 753-9(Dec. 10, 1968).

Single crystals of thulium have been grown by the strain-anneal technique. The electrical resistivity, thermal conductivity, and Seebeck coefficients were measured along the $\langle 11\bar{2}0 \rangle$ (a-axis), $\langle 10\bar{1}0 \rangle$ (b-axis), and $\langle 0001 \rangle$ (c-axis) crystallographic directions as a function of temperature from 5 to 300°K. All measurements indicated a magnetic transition near 57°K, in good agreement with a Néel temperature of 56°K as determined in earlier work by ORNL neutron diffraction group. The Seebeck coefficient measured along the c axis exhibited a second anomaly at 32°K, in agreement with low-field ac susceptibility measurements; but this anomaly did not appear in the neutron-diffraction measurements. The anomalies observed in the electrical resistivity and thermal conductivity at the Néel temperature are interpreted in terms of magnetic superzone planes. All transport properties exhibited a significant anisotropy between the a- or b-axis and c-axis directions. The high-temperature anisotropy of the electrical resistivity and the thermal conductivity is interpreted in terms of the anisotropy of the Fermi surface. (auth)

10719 MAGNETIC STRUCTURES OF Er_2O_3 AND Yb_2O_3. Moon, R. M.; Koehler, W. C.; Child, H. R.; Raubenheimer, L. J. (Oak Ridge National Lab., Tenn.). Phys. Rev., 176: 722-31 (Dec. 10, 1968).

The magnetic structures of Er_2O_3 and Yb_2O_3 have been determined by analysis of neutron diffraction data on powders and single crystals. Noncollinear antiferromagnetic structures were found, with the moment direction related to the local symmetry axis. For Er_2O_3, the moment on the C_2 site is $(5.36 \pm 0.08)\ \mu_B$ and at the C_{3i} site the moment is $(6.06 \pm 0.23)\ \mu_B$. For Yb_2O_3, the corresponding moments are $(1.86 \pm 0.06)\ \mu_B$ and $(1.05 \pm 0.06)\ \mu_B$. The Néel points are 3.4°K for Er_2O_3 and 2.3°K for Yb_2O_3. Calculations of the dipole-dipole energies for the observed structures indicate that the dipole forces are not sufficient to explain the structures. The dependence of the long-range magnetic order on the reduced temperature is the same in both systems. Good agreement with this temperature dependence was obtained by

assuming a biquadratic exchange interaction and making a simple molecular-field approximation. (auth)

10720 NEUTRON DIFFRACTION AND SUSCEPTIBILITY STUDY OF DILUTE La–RARE EARTH ALLOYS. Finnemore, D. K.; Williams, L. J.; Spedding, F. H.; Hopkins, D. C. (Ames Lab., Iowa). Phys. Rev., 176: 712-17(Dec. 10, 1968).

Neutron diffraction and susceptibility data are reported for dilute solutions of rare-earth impurity in a La host. At magnetic impurity levels of 10 and 20 at. %, the La–Tb alloys show a broad neutron diffraction peak characteristic of short-range order at 7° from the forward direction. At a magnetic impurity level of 5 at. %, this short-range order peak is absent, and the magnetic scattering in the ordered state is the same as the scattering in the paramagnetic state. Within experimental error, the Tb ions maintain their full moment and there is no change in the scattering which can be associated with spin compensation by the conduction electrons. Susceptibility data for these alloys are in many respects similar to results reported for Cu–Mn alloys, but there are important quantitative differences. Pure double-hcp La shows a nearly temperature-independent susceptibility in fair agreement with that predicted from the specific-heat density of states. (auth)

10721 NUCLEAR MAGNETIC RESONANCE IN THE METAL ReO_3: ^{185}Re AND ^{187}Re KNIGHT SHIFTS AND SPIN RELAXATION RATES. Narath, Albert; Barham, D. C. (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 176: 479-83(Dec. 10, 1968).

The NMR of ^{185}Re and ^{187}Re in ReO_3 has been studied by pulsed-resonance techniques in the temperature range 1 to 4°K. The Knight shift, referred to aqueous $NaReO_4$, is found to be $K = (-0.25 \pm 0.02)\%$. The spin–lattice relaxation rates are directly proportional to the absolute temperature, with $T_1T = 0.23 \pm 0.02$ sec°K for both isotopes. A comparison of these data with previous results for ^{183}W in the sodium tungsten bronzes Na_xWO_3 shows that the conduction-band states near the Fermi level are essentially identical in the two metals. The NMR results strongly support the view that these states are predominantly d-like. (auth)

10722 MODIFIED ORBACH RELAXATION PROCESS IN A $La(Cl, Br)_3$ MATRIX. Young, B. A.; Stapleton, H. J. (Univ. of Illinois, Urbana). Phys. Rev., 176: 502-9(Dec. 10, 1968).

The spin–lattice relaxation rates of cerium and erbium in matrices of $La(1 - x\ Cl, x\ Br)_3$ were studied. The substitution of Br^- for Cl^- in $LaCl_3$ was a technique for artificially introducing random local strains at the sites of paramagnetic impurities. The purpose was to test the earlier proposal that naturally occurring random strains were responsible for the frequent and sometimes large (≈15%) discrepancies between the excited-state energy levels as measured by optical techniques and by spin–lattice relaxation. The model assumes that the variation from site to site of Δ, the first-excited-state energy of the paramagnetic ion, can be described by a Gaussian distribution, with a standard deviation σ, centered at the optically determined value. From the relaxation data, the value of σ^2 for each sample is extracted. The theoretically predicted modifications to the temperature dependence of the Orbach relaxation mechanism are observed as σ^2 changes with the degree of Br^- substitution. Additional infrared and optical data, taken by other investigators on these samples, are briefly presented. These measurements give the actual distributions in Δ, and the widths are found to be in excellent agreement with the values of 2σ inferred from the relaxation data. (auth)

10723 MAGNETIC SCATTERING OF ELECTRONS FROM CRYSTALS AND POLARIZATION OF THE SCATTERED BEAM. Vredevoe, Lawrence A.; De Wames, Roger E. (North American Rockwell Corp., Thousand Oaks, Calif.). Phys. Rev., 176: 684-7 (Dec. 10, 1968).

The role played by the exchange interaction in the scattering of electrons from magnetic crystals has not been fully appreciated until recently. It is shown that the interference between the Coulomb and the exchange-scattering potentials can lead to large polarizations of a beam of elastically scattered low-energy electrons. A double-scattering experiment that can measure this effect is described. (auth)

10724 CRYSTALLIZATION OF ZrO_2 AND HfO_2 UNDER HYDROTHERMAL CONDITIONS. Kuznetsov, V. A.; Sidorenko, O. V. (Inst. of Crystallography, Moscow). Sov. Phys.-Cryst. (Engl. Transl.), 13: 651-2(Jan.-Feb. 1969).

Translated from Kristallografiya, 13: 748-9(July-Aug. 1968).

Experimental results are presented relative to the crystallization of ZrO_2 and HfO_2 in the temperature range 450 to 700°C. As solvents, 5 to 20% alkali solutions of NaOH, KOH, LiOH, and their combinations as well as 5 to 20% solutions of KF and NH_4F were used primarily. Individual experiments were performed with chloride (NaCl, LiCl) solutions, as well as with K_2SO_4, Na_2S, $Na_2B_4O_7$, and H_3BO_3 solutions, although recrystallization of ZrO_2 and HfO_2 for all practical purposes was not observed in these. (M.H.R.)

10725 COLUMNAR IONIZATION IN THE ELECTRON BOMBARDMENT CONDUCTIVITY OF AMORPHOUS DIELECTRICS. Ehrenberg, W.; Ghosh, B. (London Univ.). J. Phys., C (London), 2: 152-3(Jan. 1969).

New measurements are presented of conduction induced in As_2S_3 films by beta and cathode rays as a function of film thickness and incident beam current. Films between 2 and 20 μm thick were examined, the beta and cathode rays being sufficiently energetic to penetrate the films completely. It is concluded that the majority of the carriers are generated along the paths of the primary electrons and only those that escape recombination in these columns are available for conduction. The low probability of escape is responsible for the absence of saturation of the induced conduction with bias voltage. Under steady-state conditions the free path of carriers which escape recombination in the columns is normally long enough not to reduce the efficiency of their collection appreciably. (auth) (UK)

Theoretical Physics

Refer also to abstracts 10923 and 11046.

10726 (ITF-68-20) EQUATIONS FOR DENSITY MATRIX OF SUBSYSTEMS WITH FINITE NUMBERS OF FREEDOM DEGREES. Peletminskii, S. V.; Petrov, E. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 11p. (In Russian). Dep.

Equations are derived for the density matrix of subsystems with a finite number of freedom degrees in the quantum case. (auth)

10727 (JINR–E4-4111) ON THE PENETRABILITIES IN QUANTUM MECHANICS. Ixaru, Liviu Gr. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 23p. Dep.

Different definitions for the penetrability are observed. After a brief review of these definitions the author obtains exact calculation formulas, as well as WKB approximate formulas for each definition in the case of a simple potential. (auth)

10728 (NYO–3406-11) PHOTON ANALOGUE FOR THE EINSTEIN–ROSEN–PODOLSKY PARADOX. Technical Report No. 7. Nelson, M. R. (Princeton Univ., N. J. Elementary Particles Lab.). Nov. 25, 1968. Contract AT(30-1)-3406. 26p. Dep. CFSTI.

In 1935, Einstein, Podolsky, and Rosen pointed out that the interpretation given to measurements aspects of the recently evolved quantum theory led to a phenomenon which those authors considered paradoxical. An experiment was carried out to test the correlations predicted by Einstein et al. The results of this experiment are described. (M.O.W.)

10729 CALCULATION OF THE TRANSVERSE CONDUCTIVITY FOR ELECTRONS INTERACTING WITH WAVES IN STRONG ELECTRIC FIELDS. Spector, Harold N. (Illinois Inst. of Tech., Chicago). Can. J. Phys., 46: 2659-61(Dec. 1, 1968).

The transverse ac conductivity was obtained for electrons interacting with waves in the presence of strong dc electric fields. The presence of the dc electric field leads to the introduction of a drifted distribution function for the electrons and a complex, field-dependent temperature. The expression for the transverse ac conductivity can be used to find the effects of the electric field on the propagation and absorption of waves in solids which induce transverse electric fields. The results were applied to the interaction of electrons with transverse optical lattice vibrations and it was found that for all values of ql, it is the drifted distribution function which leads to the amplification of the waves. (auth)

10730 INTRODUCTION TO QUANTUM MECHANICS. SECOND EDITION. Matthews, P. T. New York, McGraw-Hill Book Company, 1968. 200p. $6.95.

The book is divided into four main sections: (1) basic formulations, (2) atomic physics, (3) nuclear physics, and (4) general theory and subnuclear physics. (M.O.W.)

10731 VAVILOV–CHERENKOV RADIATION IN A HELICAL WAVEGUIDE. Barsukov, K. A.; Svobodina, S. A. (Moscow State Teacher's Inst.). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1522-7(1968). (In Russian).

Vavilov–Cherenkov radiation arising from a charge moving along the axis of a circular helical waveguide is considered. The

spectrum and the energy of radiation are investigated. The radiation line broadening produced by losses in the helical waveguide is estimated. (auth)

10732 CERTAIN MAGNETIC FIELDS IN DIRAC–HESTENES THEORY. Casanova, Gaston. Compt. Rend., Ser. A and B, 267: 674-6(Oct. 28, 1968). (In French).

ρ_0 is different from ρ'_0 which proves that the self-presence density of electrons is different at the exterior of (Γ) and at the interior of (Γ') although the fields are both zero in these two regions, but they are not related, being separated by a cylindrical ring at the interior of which the field is different from zero. (tr-auth)

10733 LOWER BOUNDS TO SECOND-ORDER CORRECTIONS TO EIGENVALUES OF OBSERVABLES OF STATIONARY QUANTUM SYSTEMS. Sharma, C. S. (London Univ.). J. Phys. A (London), 2: 140-1(Jan. 1969).

Lower bounds to the second-order correction to the eigenvalue of an observable for the ith excited state of a stationary quantum system are found. (auth) (UK)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 9748.

Electromagnetic

Refer also to abstracts 10751 and 10782.

10734 (SLAC-PUB-501) TWO-BODY PHOTOPRODUCTION. Richter, B. (Stanford Linear Accelerator Center, Calif.). Sept. 1968. 57p. (CONF-680809-35). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

A summary is presented of high-energy photoproduction data from recent experiments at CEA, DESY, and SLAC. Data on the following are discussed and compared with theoretical models: charged single-pion photoproduction, π^0 photoproduction; photoproduction of N*(1238); and charged K-meson photoproduction. (L.B.S.)

10735 ELECTROPRODUCTION OF NEUTRAL PIONS THROUGH N*(1236). Baba, K. (Hiroshima Univ.); Kajiura, N.; Kaneko, S.; Huke, K.; Kikuchi, R.; Kobayashi, Y.; Yamakawa, T. Nuovo Cim., 59A: 53-64(Jan. 1, 1969).

Electroproduction of nucleon isobar $e + p \rightarrow e + N^*(1236)$ was measured by detecting the protons decayed into the isobar direction in coincidence with the scattered electrons. The excitation curves were observed over the N*(1236) resonance for the polarization parameter of virtual photon $\epsilon = 0.7$ and 0.5, while the squared momentum transfer q^2 was kept to 3 fm^{-2} throughout. The Coulomb and the transverse form factors, f_0 and f_-, which account for the γp N*(1236) vertex together with another transverse form factor f_+, were obtained separately from the above excitation curves. In spite of large errors involved, the result may throw some doubt on the view that the contribution of the scalar photon to the isobar production can be neglected. (auth)

10736 INVESTIGATION OF ELECTRON–PHOTON SHOWERS WITH SCINTILLATION COUNTERS. Zaimidoroga, O. A.; Kutin, V. M.; Prokoshkin, Yu. D.; Tsupko-Sitnikov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 55: 2181-7(Dec. 1968). (In Russian).

The cascade curves, fluctuations of the number of secondary electrons, and the angular divergence of showers produced in lead by 115 and 217 MeV electrons are measured. The shower characteristics are determined on the basis of an analysis of the amplitude distribution of scintillation counter pulses produced in the measurements of the number of electrons in the shower. The measurements are performed for various cut-off energies of the secondary electron spectrum. (auth)

10737 PHOTOPRODUCTION OF $\pi^-\Delta^{++}(1236)$ FROM HYDROGEN FROM 5 TO 16 GeV. Boyarski, A. M.; Diebold, R.; Ecklund, S. D.; Fischer, G. E.; Murata, Y.; Richter, B.; Williams, W. S. C. (Stanford Univ., Calif.). Phys. Rev. Lett., 22: 148-52(Jan. 27, 1969).

The cross section for $\gamma p \rightarrow \pi^-\Delta^{++}(1236)$, measured at 5, 8, 11, and 16 GeV from near-zero momentum transfer to -1 GeV^2 (-2 GeV^2 at 16 GeV), rises from small t to a maximum near $-t = m_\pi^2$, then falls as e^{12t} out to $-t \approx 0.2$ GeV^2, after which it becomes roughly equal in slope and magnitude to the single π^+ photoproduction cross section (e^{3t}). At fixed t, the cross section varies as k^{-2}, where k is the laboratory photon energy. The results do not agree well with the simple vector-dominance model. (auth)

10738 COMMENTS ON YUTA–OKUBO η ASYMMETRY MECHANISM. Gormley, M.; Hyman, E.; Lee, W.; Nash, T.; Peoples, J.; Schultz, C.; Stein, S. (Columbia Univ., New York). Phys. Rev. Lett., 22: 108-10(Jan. 20, 1969).

The asymmetry generated by the interference between the η and nonresonant background 3π amplitudes has been calculated for previously reported data in the decay $\eta \rightarrow \pi^+\pi^-\pi^0$. An upper limit of 0.23% has been found for the effect in this sample of data. (auth)

10739 ASYMMETRIC PHOTOPRODUCTION OF MUON PAIRS OFF HYDROGEN AS A TEST OF QUANTUM ELECTRODYNAMICS. Quinn, Daniel James. Stanford, Calif., Stanford Univ., 1968. 141p.

Thesis.

An experiment, performed at the Stanford Mark III electron linear accelerator is described, which measured the differential cross section for the asymmetric photoproduction of muon pairs from a hydrogen target, $\gamma + p \rightarrow \mu^- + \mu^+ + p$. The μ^- was detected under conditions where the μ^+ and proton were non-relativistic in the laboratory. The experiment was performed as a test of quantum electrodynamics (QED). The first application of Drell's proposed technique of asymmetric muon photoproduction is reported. The results of this experiment are consistent with the prediction of QED. The ratio of the measured muon counts to the counts predicted by QED was found to be 1.00 ± 0.09 (one standard deviation). QED was probed with an intermediate muon off the mass shell by an amount $E^2 - p^2 - m_\mu^2 \sim (425$ MeV). Here E and p are the energy and three-momentum carried by the virtual muon, and units with $\hbar = c = 1$ are used. Electrons of energy near 870 MeV were incident on a copper radiator 0.065 radiation lengths thick. The resulting photon beam illuminated a specially prepared target of deuterium-free hydrogen. Negative muons emerging from the target near 700 MeV/c momentum and 10° from the photon beam direction were analyzed in a magnetic spectrometer and detected in a six-counter telescope containing copper and tungsten for discrimination against pions and electrons. Negative pions could not be photoproduced singly in the pure hydrogen target due to charge conservation. The incident photon energy was kept below the energy necessary to photoproduce a pion pair with the π^- at the spectrometer momentum. (Disser. Abstr.)

10740 ELECTRODYNAMICS AT SMALL DISTANCES, LEPTONIC DECAYS OF VECTOR MESONS AND PHOTOPRODUCTION OF VECTOR MESONS. Ting, S. C. C. (Massachusetts Inst. of Tech., Cambridge. Deutsches Elektronen-Synchrotron, Hamburg). pp 43-71 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Recent experiments on quantum electrodynamics are summarized, which show that first-order quantum electrodynamics of electrons and photons is valid, to at least 5% level, in both the space-like and the time-like region, and up to a momentum transfer of 1 GeV/c with a corresponding cut-off $\Lambda > 2$ GeV at a 68% confidence level. Experiments designed to measure the coupling between photons and vector mesons are then discussed. The large amount of accurate data on leptonic decays of vector mesons (ρ, ω, ϕ) from both production experiments and colliding beam experiments are found to be in good agreement. A comparison of the average values of $V^0 \rightarrow l^+ + l^-$ with various theoretical models is shown. Experimental data on the photoproduction of ρ, ω, and ϕ are discussed and summarized, and comparison is made with predictions of diffraction models. Total photon-hadron cross sections and upper limits for rare decays of vector mesons are briefly discussed. (L.B.S.)

Weak

Refer also to abstract 10740.

10741 (UCRL-18143) MEASUREMENT OF THE MUON POLARIZATION VECTOR IN $K^+ \rightarrow \pi^0 + \mu^+ + \nu$. Cutts, David (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1968. Contract W-7405-eng-48. 126p. Dep. CFSTI.

Thesis.

The parameter ξ in the decay $K^+ \rightarrow \pi^0 + \mu^+ + \nu$ ($K_{\mu 3}$) was determined from a muon polarization measurement carried out with spark chambers at the Bevatron. The parameter ξ, which may be complex and energy dependent, describes phenomenologically the manner in which the basic weak interaction responsible for the $K^+ \rightarrow \pi^0 + \mu^+ + \nu$ decay is modified by the strong interactions of the K and π mesons. Because ξ is determined by the structure of the K and π mesons, it is frequently called a form factor. In the experiment K^+ mesons from a 500 MeV/c separated beam were brought to rest in a carbon stopper surrounded by lead-plate spark chambers to detect the two photons from the π^0. Muons were stopped in a magnetic-shielded aluminum-plate spark chamber. The data consist of 3133 events with μ-e decays and complete kinematics for $K_{\mu 3}^+$. From the angular distribution of the decay electrons the vector was determined giving the polarization and related this measurement to a determination of the parameter ξ. The data are statistically consistent with the assumption that ξ does not depend on momentum transfer. Assuming ξ constant, the result is $\xi = (-0.9^{+0.7}_{-1.1}) + (-0.3 \pm 0.5)$. This result is compatible

with Imξ = 0 as would be required by time-reversal invariance. If the data are analyzed imposing the constraint that ξ be real it is found that $\xi = -0.95 \pm 0.3$. The muon polarization along the direction predicted by these values for ξ is $+0.9 \pm 0.1$, in agreement with the value +1 required by theory. In a calibration experiment the muon longitudinal polarization in the decay $K^+ \rightarrow \mu^+ + \nu$ was found to be -1.0 ± 0.1. This result is evidence of the adequacy of the technique, as the polarization is known to be −1. (auth)

10742 P-WAVE DECAYS OF HYPERONS. Nishijima, Kazuhiko (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 40: 912-14(Oct. 1968).

Characteristic features of the P-wave decay amplitudes of hyperons suggested by experiment are given. The relative P-wave decay amplitudes for nonleptonic hyperon decays are tabulated, and the relative S-wave decay amplitudes derived from the vector-meson-exchange-dominance model are also tabulated for comparison. (W.H.K.)

10743 THE RADIO A/V IN THE BETA DECAY OF THE Λ^0 HYPERON. Conforto, G. (CERN: Geneva). pp 427-41 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

Experimental data on the ratio of the axial vector to the vector coupling constant are presently available from four different experiments for the decay $\Lambda \rightarrow p + e^- + \bar{\nu}$. The experimental data are briefly reviewed, and combined to obtain a rather precise determination of the C_A/C_V ratio. A brief summary is given of the definition and of the properties of the likelihood functions used in the analysis of the data. (L.B.S.)

10744 EXPERIMENTAL INVESTIGATIONS OF $\Delta S/\Delta Q$ RULE IN LEPTONIC K^0 DECAYS. James, F.; Briand, H. (Institut de Physique Nucleaire, Paris). Nucl. Phys., B8: 365-76(1968).

A study of 600,000 stopping antiproton annihilations in the Saclay 81 cm hydrogen bubble chamber has yielded about 12,000 visible K^0 decays, and after many cuts to eliminate background, 121 leptonic K^0 decays. Straightforward consideration of the time distribution of these leptonic decays yields the following values for the $\Delta S = \Delta Q$ violating parameter X: $\mathrm{Re}(X) = 0.09^{+0.13}_{-0.15}$, and $\mathrm{Im}(X) = -0.22^{+0.28}_{-0.37}$. (auth)

10745 WEAK INTERACTIONS AND CP VIOLATION: EXPERIMENTAL. Cronin, J. W. (Princeton Univ., N. J.). pp 281-303 of 14th International Conference on High-Energy Physics, Vienna, 28 August-5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

A review is given of experimental contributions to the High-Energy Physics Conference on weak interactions and CP violation. Emphasis is given to those areas where there are significant problems or where there has been significant progress. Some topics discussed include direct muon production in cosmic rays, K-meson decays, leptonic hyperon decays, CP violation in $K \rightarrow 2\pi$, and C, CP, and CPT violation in other systems. (L.B.S.)

Strong (Baryon-Induced)

Refer also to abstract 10931.

10746 (UCRL-18306) FOUR-BODY STRANGE PARTICLE PRODUCTION IN pp COLLISIONS AT 6 GeV/c. Klein, Stanley Lewis (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1968. Contract W-7405-eng-48. 120p. Dep. CFSTI.

Thesis.

An exposure of the LRL 72-in. liquid-hydrogen bubble chamber to 6 GeV/c protons has yielded some 3000 examples of production of strange particles in four-body final states. Cross sections for the reactions $pp \rightarrow AK^0p\pi^+$, $pp \rightarrow AK^+p\pi^0$, and $pp \rightarrow AK^+n\pi^+$ are 64 ± 6 μb, 39 ± 6 μb, and 43 ± 4 μb, respectively. The resonances K*(890), N*(1236), and Y*(1385) are produced. In addition, the quasi-two-body reaction $pp \rightarrow NN^*(1950)$, $N^* \rightarrow Y^*K$ is observed. Except for the low Kπ effective mass region, the data are found to be in good agreement with a pion exchange model. (auth)

10747 NEUTRON-PROTON ELASTIC SCATTERING FROM 3 TO 10 GeV. Besliu, C. (Bucharest State Univ.); Besliu, T.; Constantinescu, A.; (and others). Nuovo Cim., 59A: 1-8(Jan. 1, 1969).

New data on the neutron-proton differential elastic cross section in the momentum-transfer range from 0.06 to 0.30 $(\mathrm{GeV/c})^2$, for two energy regions (from 3 to 6 GeV and from 6 to 10 GeV), are reported. (auth)

10748 FOUR-PION FINAL STATE IN THE $\bar{p}n$ ANNIHILATION AT REST. Laakso, Ilkka (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome. Univ. of Turku, Finland). Ann. Acad. Sci. Fenn., Ser. A. VI, No. 292, 1-35(1968).

The final state $\pi^+\pi^-\pi^0$ was studied experimentally in $\bar{p}n$ annihilation at rest with a deuterium bubble chamber. The investigation was part of the general study of the $\bar{p}n$ annihilation undertaken by the Syracuse-Rome collaboration. A total of 6019 events were collected. The channel contributes $17.8 \pm 2.0\%$ of the $\bar{p}n$ annihilations. The analysis seemed to reveal considerable amount of two-meson annihilation, and a very scarce production of four uncorrelated pions. Possible interpretations of a 1.15 GeV, I = 0 two-pion effect were discussed. Results are given on the channel $\pi^+\pi^-\pi^-$ + (missing mass), obtained as a by-product. (auth)

10749 COHERENT PRODUCTION OF THE $p\pi^+\pi^-$ ENHANCEMENT AT 1470 MeV BY 28 GeV/c PROTONS OF NEON. Hudson, F. R.; Miller, D. J.; O'Neall, J. S. (Brookhaven National Lab., Upton, N. Y.). Nucl. Phys., B8: 391-401(1968).

In a bubble-chamber experiment with 28 GeV/c protons in a neon-hydrogen mixture, coherent production of $p\pi^+\pi^-$ on neon has been observed. All of the available evidence indicates that the enhancement in $p\pi^+\pi^-$ mass which we see in the region of 1470 MeV is the same as has been observed in high-energy pp experiments. A double-Regge model gives quite good agreement with the data, without needing any explicit resonance production. Calculations with a nuclear absorption model have given limits of between 30 mb and 70 mb for the emerging $p\pi^+\pi^-$ system with mass less than 1.6 GeV. The cross section for coherent production of $p\pi^+\pi^-$ in this mass range is found to be 470 ± 100 μb. (auth)

10750 NUCLEON RESONANCES IN PRODUCTION PROCESSES. Rushbrooke, J. G. (Cambridge Univ., Eng.). pp 158-69 of 14th International Conference on High-Energy Physics, Vienna, 28 August-5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Experimental data on nucleon resonances in production processes are surveyed. Some methods of analysis which may be useful for future high statistics experiments are reported. Inelastic decay modes of resonances are discussed. Particular attention is given to the P_{11} Roper resonance in a context where Deck background is possible. (L.B.S.)

10751 PROTON PROTON BREMSSTRAHLUNG AT 20 MeV. Bahnsen, Axel. New York, Univ. of Rochester, 1968. 116p.

Thesis.

The proton-proton bremsstrahlung cross section was measured at 20 MeV beam energy. The "Harvard" geometry was used, with two proton detectors at 35° to the beam direction. The detectors used were position-sensitive solid state detectors, oriented perpendicular to the plane containing the beam. With this arrangement, the distribution of events with the azimuthal angle ϕ could be measured, with an angular definition of ±1°, due mainly to the beam size. A pair of large plastic scintillators, positioned at 90° to each solid state detector, were used as anticoincidence counters to decrease the large background of elastic proton counts. The cross section $d^2\sigma/d\Omega_1 d\Omega_2$ was measured to be 1.1 μb/sr^2, averaged over the kinematically allowed ϕ-range. The uncertainty, which is dominated by the statistical uncertainty, is ±0.35 μb/sr^2. The measured variation with ϕ indicates that the coplanar cross section is about 10% larger than the quoted cross section, in agreement with phase space considerations, which predict 20%. Recent theoretical calculations are reviewed, some of which are found to be in good agreement with this measurement. The experiment is described, with special attention given to sources of systematic errors, which may influence the measurement of such small cross section. (Disser. Abstr.)

Strong (Meson-Induced)

Refer also to abstract 10939.

10752 TWO-PRONG PLUS VEE TOPOLOGY IN K^+p INTERACTIONS AT 13 GeV/c. Forman, Barbara Eve. Rochester, N. Y., Univ. of Rochester, 1968. 178p.

Thesis.

The Brookhaven National Laboratory's 80-inch liquid hydrogen bubble chamber was exposed to an rf separated beam of K^+ mesons having a laboratory momentum of 13 BeV/c. Collisions resulting in two charged prongs plus a neutral vee were studied. A sample of 2313 events was obtained; the corresponding observed cross section is 0.90 ± 0.09 mb. When the results were corrected for unseen decays, cross sections were determined for events of the

following types: 2 charged prongs + K^0, 2 charged prongs + A, and 2 charged prongs + $\bar{\Lambda}$. Within these categories, the five final states, for which the production cross sections are given, were studied: $K^+p \rightarrow K^+K^+\Lambda$, $pp\bar{\Lambda}$, $p\pi^+K^0$, $p\pi^+K^0\pi^0$, and $\pi^+\pi^+K^0$ + n. The $p\pi^+K^0\pi^0$ final state is dominated by a singly charged $K\pi\pi$ enhancement between 1100 and 1400 MeV. This enhancement is also observed in the 4-prong $p\pi^+K^+\pi^-$ final state; the 2-prong plus vee $p\pi^+K^0\pi^0$ events were combined with 395 4-prong events ($\sigma = 950 \pm 100$ μb) to study this effect which we call Q. Both resonance production and kinematic enhancement hypotheses were used to analyze the Q. Under the resonance assumption, evidence is presented in favor of a 0^+ exchange mechanism for Q production in K^+p collisions and its J^P is found to be 1^+. The Q decays mainly into $K^*(890)\pi$ and $K\rho$. It was found that the Q has I = ½, M = 1280 ± 20 MeV, and Γ = 130 ± 15 MeV. The L meson is also seen in the singly charged $K\pi\pi$ mass spectrum. From a comparison of the $K\pi\pi$ distributions in the $p\pi^+K^+\pi^-$ and the $\pi^+\pi^+K^0n$ final states, the L meson was shown to have I = ½. The following quasi two body final states were observed: (1) $K^*(890)p$, (2) $K^*(1420)p$, (3) $N^{*++}K^0$, and (4) $N^{*++}K^*(890)$, $K^* \rightarrow K^+(K^0)K^+(K^0)$. The cross sections for these reactions are rapidly decreasing functions of energy; they are a factor of 10 lower than the corresponding cross sections at 3 BeV/c incident K^+ momentum. From a study of the resonance decay density matrix elements [of the K^* for (1) and the N^* for (3)], it was found that the reactions $K^+p \rightarrow K^*(890)p$ and $K^+p \rightarrow N^{*++}K^0$ proceed by vector meson exchange, a result consistent with studies at lower K^+ energies. An analysis of the N^* and K^* decays in the N^*K^* final state indicated that, as at lower energies, the reaction $K^+p \rightarrow N^{*++}K^{*0}$ proceeds by one-pion exchange. A search was made for a B = +1, S = +1 enhancement in the $p\pi^+K^0$, $p\pi^+K^0\pi^0$, and $\pi^+\pi^+K^0n$ final states. No evidence was found for any Y = 2 enhancement. (Diss. Abstr.)

10753 DIFFRACTION DISSOCIATION AND 5.5 GeV/c $K^+p \rightarrow$ 4 PRONGS. Luste, George Juris. Baltimore, Johns Hopkins Univ., 1968. 325p.

Thesis.

Four and five particle final states in K^+ meson–proton collisions at 5.5 GeV/c are studied. The following reactions are examined and their cross sections are determined: (1) $K^+p \rightarrow \pi^-\pi^+K^+p$ (1.8 mb); (2) $K^+p \rightarrow \pi^-\pi^+K^+p\pi^0$ (1.2 mb); (3) $K^+p \rightarrow \pi^-\pi^+\pi^+K^+N$ (.5 mb); (4) $K^+p \rightarrow \pi^-\pi^+\pi^+pK^0$ (not seen) (.5 mb); and (5) $K^+p \rightarrow$ no fit (1.3 mb). The fitted event mass resolution is found to be less than 20 MeV/c^2. Reaction (1) is studied in detail. It is subdivided into the following four major and mutually exclusive classes. (I) $K^+p \rightarrow \pi^-\pi^+K^+p$ (no K^*, no N^*) (.3 mb.); (II) $K^+p \rightarrow N^{*++}(1238)\pi^-K^+$ (.3 mb.); (III) $K^+p \rightarrow K^{*0}(890)\pi^+p$ (.4 mb); and (IV) $K^+p \rightarrow K^{*0}(890)N^{*++}(1238)$ (.7 mb.). Classes II and III are shown to be examples of a two body dissociation model. The dissociation point of view is discussed and also shown to be relevant in other reactions. The Ross-Yam formulation of the diffraction dissociation model is thoroughly investigated, but found to be inadequate in explaining the K^*n data. The $K^{*0}\pi^+$ mass peaking from 1050 to 1450 MeV cannot be reproduced by Monte Carlo simulations of this model. Some of the angular distributions disagree with the model as well. A systematic search and study is made of every mass combination in reaction 1. Monte Carlo background models are used to identify the K^* and N^* reflections. In class I, the ρ^0 production and perhaps a $K\rho$ (1280 MeV) is seen. In class II, the $N^{*++}\pi^-$ threshold enhancement is examined, the $K^+\pi^-$ is observed as the K^* (1400) and a general excess of events in the $K^+\pi^-$ mass spectrum from 980 to 1320 MeV is seen. In class III, the $K^{*0}\pi^+$ 1300 MeV region is examined. The data does not show any structure from 1050 to 1450 and disagrees with CERN at 5.0 GeV/c, who see four separated resonances. The spin parity is found to be 1^+ or 2^+ for the $K^*\pi$ mass spectrum from 1050 to 1450 MeV. The class IV final state, on the basis of K^* and N^* decay distributions, is seen to be consistent with a one pion exchange model. The reactions 2, 3, and 4 are examined for possible new resonances, but no strong evidence for any is observed. (Diss. Abstr.)

10754 THE REACTION $K^+p \rightarrow KN\pi$ AT 3 GeV/c, INCLUDING THE PRODUCTION AND DECAY OF RESONANCES. Saellstroem, P.; Blomqvist, G. (Univ. of Stockholm). Ark. Fys., 37: 463-88 (1968).

The reaction $K^+p \rightarrow KN\pi$ was studied in all three final charge states at a momentum of the incident K-mesons of 2.97 GeV/c, i.e., a total CM energy of 2.60 GeV. The production cross section for K^* is found to be (1.4 ± 0.2) mb and for $K^*(0.9 \pm 0.1)$ mb. The decay angular correlations for the two decay modes of K^*, $K^* \rightarrow K^0\pi^+$ and $K^* \rightarrow K^+\pi^0$ were found to be different. This can be explained as due to an interference between states of different total isospin of the $K\pi$ system. The K^* decay angular correlations, when interface effects are eliminated, indicate that the resonance is produced to a great extent by exchange of a vector meson. The spin density matrix elements for N^* are in agreement with the predictions of the models of Stodolsky and Sakurai. The modified one-particle exchange model of Jackson et al. gives a reasonable account of the production differential cross sections as well as of the variations of the matrix elements with the production angle of the resonance. The same is true of the Regge Pole model. The double peripheral model, applied to the reaction $K^+p \rightarrow K^+n\pi^+$ gives a reasonable description to the cross sections if (π^+,K^{*0}) and (ρ^+,ω) exchanges are assumed together with a non-peripheral background. (auth) (Swed)

10755 SOME ASPECTS OF RESONANCE PRODUCTION AND DIFFRACTION-DISSOCIATION IN 5.44 GeV/c K^+p INTERACTIONS. Gillespie, Daniel Thomas. Baltimore, Johns Hopkins Univ., 1968. 273p.

Thesis.

This dissertation consists of two parts. The first part describes the analysis of bubble chamber events of the types (1) $K^+ + p \rightarrow K^0 + p + \pi^+$ (475 events); (2) $K^+ + p \rightarrow K^0 + p + \pi^+ + \pi^0$ (900 events); and (3) $K^+ + p \rightarrow K^0 + n + \pi^+ + \pi^+$ (206 events). The respective cross sections are calculated to be 0.80 ± 0.09 mb, 1.45 ± 0.15 mb and 0.34 ± 0.05 mb. From 20% to 25% of the reaction (1) events are found to proceed via the quasi-two-body channel $K^{*+}(892) + p$, and an approximately equal number via the channel $N^{*++}(1236) + K^0$. The production angular distributions and spin-space density matrix elements of the $K^{*+}(892)$ and $N^{*++}(1236)$ resonances are obtained, and a comparison is made with the predictions of the absorption model; the agreement is moderate but not complete. A $K^{*+}(1410)$ signal is observed, but it is smaller by a factor of ten than the $K^{*+}(892)$ signal. Reaction (2) exhibits abundant formation of the resonances $K^{*+}(892) \rightarrow K^0 + \pi^+$, $K^{*0}(892) \rightarrow K^0 + \pi^0$ and $N^{*++}(1236) \rightarrow p + \pi^+$, and moderate formation of the resonances $N^{*+}(1236) \rightarrow p + \pi^0$ and $\rho^+(765) \rightarrow \pi^+ + \pi^0$. Reaction (3) shows a strong signal due to $K^{*+}(892) \rightarrow K^0 + \pi^+$, and weaker signals attributed to $N^{*+}(1236) \rightarrow n + \pi^+$, $K^{*+}(1410) \rightarrow K^0 + \pi^+$, $N^{*+}(1526) \rightarrow n + \pi^+$ and $N^{*+}(1670) \rightarrow n + \pi^+$. In the $K^0\pi^+\pi^0$ mass spectrum of reaction (2) a broad enhancement is seen in the 1200–1500 MeV/c^2 region, as well as a small bump in the vicinity of the $L^+(1780)$ mass. The 1300 MeV/c^2 enhancement is associated with the region $\Delta^2(p/p) < 0.5$ (GeV/c)^2, and also seems to occur in conjunction with all three resonances, $K^{*+}(892)$, $K^{*0}(892)$ and $\rho^+(765)$. Reactions (2) and (3) together contain three $K^+ + p \rightarrow K^* + N^*$ channels. To within an estimated statistical uncertainty of about 25%, it is found that the cross sections for these three channels are in the ratios predicted by isospin invariance. However, when compared to the reported K^*N^* cross section in the final state $K^+\pi^-p\pi^+$, our values are lower by a factor of ½ than what would be expected from isospin invariance. Investigations into this seeming disparity are continuing. In the second part, an investigation is made of the Ross-Yam diffraction-dissociation (DD) model and its predictions for the reaction $K^+ + p \rightarrow p + K^{*0}(892) + \pi^+$, $K^{*0} \rightarrow K^+ + \pi^-$ at 5.44 GeV/c. This investigation is carried out by a Monte Carlo procedure, the details of which are systematically developed in the text and appendices. It is found that the DD model fails to fully account for the experimentally observed $K^{*0}\pi^+$ mass enhancement at 1300 MeV/c^2. It is also found that the DD model predicts values for the K^{*0} spin-space density matrix elements which are in qualitative agreement with the data, although there are definite quantitative differences. Finally it is found that the total DD cross section increases linearly with the K^+ lab momentum, in sharp disagreement with the relatively constant value observed experimentally. In summary, the DD model is found to be inadequate in its present form; however, it is felt that further efforts toward improving its formulation are warranted. Under the assumption that the 1300 MeV/c^2 enhancement in the $K^{*0}\pi^+$ mass spectrum is due to a single resonance, a Berman-Jacob analysis indicates that the spin-parity of the resonance is either 1^+ or 2^+. However, virtually identical results are obtained when this analysis is applied to a like sample of DD Monte Carlo events. This suggests that the resonance may be strongly interfering with, and reacting upon, a "DD background"; if true, this would render extremely difficult an accurate determination of the true mass and width of the resonance. (Diss. Abstr.)

10756 BACKWARD π-p ELASTIC SCATTERING AT 1.5 ~ 3.5 GeV/c AND PARITY DOUBLETS OF NUCLEON RESONANCES. Minami, Shigeo (Osaka City Univ.). Progr. Theor. Phys. (Kyoto), 40: 1068-78(Nov. 1968).

Differential cross sections for π^--p charge exchange scattering at 180° are predicted on the basis of the analysis of backward π^+-p elastic scattering at 1.5 ~ 3.5 GeV/c. A possible model for the nucleon resonances is suggested in order to explain the data for background π^+-p elastic scattering and photoproduction of π^0 in the background direction. (auth)

10757 EXPERIMENTAL TESTS OF THE QUARK MODEL USING THE REACTION $K^-p \rightarrow K^*\Delta$ AT 2.6 GeV/c. Friedman,

Jerome H.; Ross, Ronald R. (Univ. of California, Berkeley). Phys. Rev. Lett., 22: 152-6(Jan. 27, 1969).

Predictions of the quark model of high-energy scattering are tested by using the reaction $K^-p \to K^*\Delta$. All predictions are satisfied when interpreted as applying in the t-channel coordinate system. (auth)

10758 RESONANCE FORMATION IN THE REACTIONS $K^-p \to K^+\Xi^-$ AND $K^-p \to K^0\Xi^0$ IN THE MASS REGION FROM 1915 TO 2168 KeV. Burgun, G. (CEN, Saclay, France); Meyer, J.; Pauli, E.; (and others). Nucl. Phys., B8: 447-59(1968).

Total and differential cross sections for the reactions $K^-p \to K^0\Xi^0$ were measured between 1.26 and 1.84 GeV/c in a hydrogen bubble chamber. Evidence for resonance formation is presented and discussed. (auth)

10759 THE TOTAL PHOTONUCLEAR CROSS SECTION AT HIGH ENERGIES AS DETERMINED FROM THE NEUTRON PRODUCTION BY FAST MUONS. Allkofer, O. C.; Andresen, R. D. (Univ., Kiel). Nucl. Phys., B8: 402-12(1968).

A study has been made of the production of evaporation neutrons in the interaction of high-energy muons with lead nuclei. The detected neutrons arise from the direct electromagnetic interaction of the fast muons with lead nuclei and the interaction of photons from cascades initiated by knock-on electrons. Information about the total photonuclear cross section at high energies can be obtained from this muon interaction experiment by considering the virtual photon spectrum of the muons. The measured value of the product of the cross section per lead atom and mean multiplicity corresponds to those calculated on the Kessler theory under the assumption of a constant photonuclear cross section above 1 GeV. The experimental results disagree with the assumptions made by Hodgson and Jameel who predict a decrease of the total photonuclear cross section at high energies. (auth)

10760 QUASI-TWO-BODY REACTIONS IN 13 GeV/c K^+p INTERACTIONS. Berlinghieri, J. C.; Farber, M. S.; Ferbel, T.; Forman, B. E.; Melissinos, A. C.; Sattery, P. F.; Yuta, H. (Univ. of Rochester, N. Y.). Nucl. Phys., B8: 333-8(1968).

The final states pK^{*+} (890), K^0N^{*2+} (1236), and K^{*0} (890) N^{*2+} (1236) as produced in 12.7 GeV/c K^+p interactions are studied. The density matrix elements and t-distributions have been obtained and are compared to theoretical models. (auth)

10761 THE $\bar{K}N$ INTERACTION FROM 800 TO 1200 MeV/c. I. K^-p CROSS SECTIONS. Armenteros, R. (CERN, Geneva); Ferro-Luzzi, M.; Leith, D. W. G. S.; (and others). Nucl. Phys., B8: 233-64(1968).

K^-p reactions have been studied at 23 different momenta between 777 and 1226 MeV/c. This interval corresponds to a mass range of the $\bar{K}N$ system from 1688 to 1897 MeV. About 350,000 photographs were taken in the 81 cm Saclay hydrogen bubble chamber, exposed to a separated K^- beam at the CERN proton synchrotron. A total of about 100,000 events were analyzed and partial and differential cross sections were determined; polarizations were also obtained for those reactions where the decay of the Λ or Σ^+ hyperon allowed their measurement. The data for all the channels are presented except those corresponding to two-prong configurations, which make the subject of a separate investigation. (auth)

10762 THE $\bar{K}N$ INTERACTION FROM 800 TO 1200 MeV/c. II. K^-p AND $\bar{K}N\pi$ FINAL STATES FROM AN ANALYSIS OF TWO-PRONG EVENTS. Conforto, B. (Univ. of Chicago); Harmsen, D.-M.; Lasinski, T.; (and others). Contract AF 49(638)-1652. Nucl. Phys., B8: 265-302(1968).

The reactions $K^-p \to K^-p$ and $K^-p \to \bar{K}N\pi$ have been studied at 24 momenta between 777 and 1226 MeV/c. For this purpose about 71,000 two-prong events were analyzed, from photographs taken in the 81 cm Saclay hydrogen bubble chamber, exposed to a separated K^- beam at the CERN proton synchrotron. Presented here are the partial and differential $K^-p \to K^-p$ cross sections together with a detailed description of the experimental procedure adopted in their determination. The analysis of resonance formation in $K^-p \to \bar{K}N$ previously reported has been updated using these new $K^-p \to K^-p$ data. Cross sections for $K^-p \to K^-p\pi^0$, $K^-n\pi^+$, and $\bar{K}^0p\pi^-$ are also given. The analysis of resonance production and formation for these channels will, however, be reported elsewhere. (auth)

10763 OBSERVATIONS OF A BACKWARD PEAK IN $\pi^-p \to p\rho^-$ AT 8 AND 16 GeV/c. Anderson, E. W. (Brookhaven National Lab., Upton, N. Y.); Bieser, E. J.; Blieden, H. R.; (and others). Phys. Rev. Lett., 22: 102-5(Jan. 20, 1969).

Differential cross sections for ρ^- production near 180° in the reaction $\pi^-p \to p\rho^-$ at 8 and 16 GeV/c are given. These cross sections, which cover a range of $|u| \leq 0.6$ (GeV/c)^2, are well represented by the formula $d\sigma/du = A \exp(Bu)$ and are comparable in magnitude to backward π^-p elastic cross sections. Results are compared to Regge model calculations. (auth)

10764 EXPLORATORY DEDUCTIONS AT LARGE t FROM NEW πN DATA. Barger, V. (Univ. of Wisconsin, Madison); Phillips, R. J. N. Contract AT(11-1)-881. Phys. Rev. Lett., 22: 116-18(Jan. 20, 1969). (COO-881-201).

The significance of new $\pi^\pm p$ polarization data for Regge exchange models is extracted and correlated with dips and bumps in recent $d\sigma/dt$ measurements. A semiquantitative description of the data through the entire region $0 < -t < 4$ (GeV/c)^2 is presented. As a byproduct, the $\pi^\pm p$ polarization and $\pi^-p \to \pi^0n$ differential cross section are extrapolated into the region $-t > 2$, where there are no data yet. (auth)

10765 STRANGE BARYON RESONANCES. Tripp, R. D. (Univ. of California, Berkeley). pp 173-92 of 14th International Conference on High-Energy Physics, Vienna, 28 August-5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Experimental data on strange baryon resonances are reviewed and examined. Resonances in the Λp dibaryon system, and baryon states with $S = +1, -2$, and -1 are discussed. Information on baryon resonances within the framework of SU(3) is summarized. An updated version is presented of the status of decay rates and relative phases of baryon resonance decays into stable baryons and mesons. (L.B.S.)

10766 NUCLEON RESONANCES. Donnachie, A. (Univ. of Glasgow). pp 139-58 of 14th International Conference on High-Energy Physics, Vienna, 28 August-5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Experimental data on nucleon resonances produced in the following reactions are reviewed: $\pi + N \to \pi + N$; $\pi + N \to \eta + N$; $\pi^- + p \to K^0 + \Lambda^0$; $\pi + p \to K + \Sigma$; $\pi + N \to \pi + \pi + N$; and $\gamma + N \to \pi + N$. Data tabulations are presented of the status of modes of observed $\pi - N$ resonance decays other than into pion-nucleon, and of the classification of pion-nucleon resonances in the 1-excitation quark model with parafermi statistics. (L.B.S.)

10767 MESON RESONANCES. French, B. (CERN, Geneva). pp 91-136 of 14th International Conference on High-Energy Physics, Vienna, 28 August-5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Following a brief mention of statistical problems, some of the quasi-theoretical notions which have been useful to experimentalists are noted: quark model, mass formulas, SU(3) branching ratios, and Regge trajectories. Recent data on meson states are discussed in section 2, proceeding systematically through $I = 0$, $I = 1$, and finally the $I = \frac{1}{2}$ states of mass <1600 MeV. Data in the R region (1600 MeV) -1880 MeV, and the mass region $>2M_{nucleon}$ are discussed. Different aspects of meson physics are discussed in the last section. (L.B.S.)

Particle Interactions and Properties (Theoretical)

General

10768 (IFVE-STF-68-11-K) PARTICLE INTERACTION AT HIGH ENERGIES. Ter-Martirosyan, K. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1968. 96p. (In Russian). Dep.

The present status of the theory of the high-energy elementary particle interaction is reviewed. The predictions of the theory are compared with the latest experimental data. (auth)

10769 (NP-17735) LORENTZ COVARIANT WAVE FUNCTIONS AND EQUATIONS FOR ELEMENTARY SYSTEMS. Fonda, Luciano; Ghirardi, Gian Carlo (Cincinnati Univ., Ohio. Dept. of Physics. Trieste Univ. (Italy). Istituto dei Fisica). [1968]. 81p.

A detailed and unified description is given of the procedures which must be followed for all cases of physical interest to go from the wave functions carrying an irreducible representation of the restricted Poincaré group, to objects having a manifestly covariant behavior. As well known, for instance for the case of spin

½ massive particles, this amounts to performing the inverse of a Foldy–Wouthuysen transformation. Before coming to the main subject of the paper, the construction of the irreducible representations of the restricted and extended Poincaré group is reviewed. Particular emphasis is given to the physical meaning of the representations and of the invariants which characterize them. After this, manifestly covariant quantities are derived from the wave functions of the irreducible representations of the restricted group for spin 0, ½ and 1, massive and massless elementary systems. The corresponding relativistically invariant equations, i.e., the Klein–Gordon, Dirac, Proca, Weyl, and Maxwell equations are then derived. The transformation properties under the transformations of the extended group are also extensively discussed. (auth)

10770 RELATIVISTIC KINEMATICS. Werbrouck, A. (Istituto Nazionale di Fisica Nucleare, Turin). pp 1-31 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

The lecture on relativistic kinetics deals with Lorentz transformations, two-body collision and decay processes, three-or-more body decay processes, and spin or polarization transformations. (L.B.S.)

10771 METHODS IN SUBNUCLEAR PHYSICS. VOLUME I. Nikolic, M. (ed.). International School of Elementary Particle Physics, Herceg-Novi (Yugoslavia). New York, Gordon and Breach, Science Publishers, Inc., 1968. 510p. $30.00 cloth, $14.00 paper.

Separate abstracts are prepared for the twelve lectures included in Vol. 1. (L.B.S.)

For abstracts of individual papers see: 9748, 10743, 10770, 10783, 10784, 10799–10801, 10834, 10839, 10840, and 10862.

10772 LOCALIZABILITY FOR PARTICLES OF MASS ZERO. Amrein, W. O. (Univ., Geneva). Helv. Phys. Acta, 42: 149-90 (Feb. 15, 1969).

The consequences of the concept of weak localizability which was recently introduced by Jauch and Piron are investigated. It is found to be the appropriate mathematical tool for describing the localization of particles of given helicity in relativistic quantum mechanics. It treats particles of mass zero and those of positive mass on an equal footing. Particles of one fixed value of the helicity and spin $J \neq 0$ can never be described by states which are localized in a finite region of space. The neutrinos fall into this category. Particles which may exist in superpositions of states of different helicities (such as photons) can be localized in arbitrarily small volumes. It is shown that the localization of any particle is closely related to its energy density, but that this relation is always non-local. At large distances d from the region of localization of a particle of mass zero, its energy density does not vanish but falls off as d^{-7}. Explicit expressions are given for the operators representing the number of particles localized in an arbitrary volume of space in relativistic quantum field theory. They are compared with a similar expression given by Mandel for the photon field. (auth)

10773 SOME REMARKS ON THE THEORY OF INTERACTING MANY FERMIONS IN ONE DIMENSION. Lee, M. Howard (Univ. of Alberta, Edmonton). Progr. Theor. Phys. (Kyoto), 40: 990-7 (Nov. 1968).

The early work of Tomonaga on the interacting many fermions in one dimension is briefly examined in relation to the theories of Gell-Mann and Brueckner and others. It is shown that the Tomonaga theory has a close relationship to these other theories. Also the momentum distribution of an interacting system is explicitly calculated by a perturbative method. The result is consistent with the more general conclusions of Migdal and Luttinger. (auth)

10774 BEHAVIOR OF THE DIFFRACTION PEAK FOR PARTICLES WITH ARBITRARY SPINS. Hong, Nguyen Thi (Joint Inst. for Nuclear Research, Moscow). Nucl. Phys., B8: 303-10 (1968).

It is shown that the lower bound for the width of the diffraction peak at $s \to \infty$: $\Delta \gtrsim \text{const}/\ln^2 s$, obtained by Logunov et al. for spinless particles holds also for particles with arbitrary spins. (auth)

10775 14th INTERNATIONAL CONFERENCE ON HIGH-ENERGY PHYSICS, PROCEEDINGS, VIENNA, 28 AUGUST–5 SEPTEMBER 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968. 537p. Sw.Fr. 50.-. (CONF-680809).

A total of nearly one thousand papers were presented at the conference. The proceedings is limited to the rapporteurs' talk and a few closely related discussions. A complete list of titles and authors of the papers submitted is included. Four of the twenty papers included were previously abstracted for NSA. Separate abstracts are prepared for the remaining papers. (L.B.S.)

For abstracts of individual papers see: 10740, 10745, 10750, 10765–10767, 10776, 10796, 10804–10807, 10816, 10817, 10843, and 10898.

10776 FUNDAMENTAL THEORETICAL QUESTIONS. Wightman, A. S. (Princeton Univ., N. J.). pp 431-41 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.
See CONF-680809.

A summary is presented of some of the papers dealing with S-matrix theory and field theory. Comments are also made on some relevant progress made, since the XIII conference on High-Energy Physics, in papers not submitted. (L.B.S.)

Electromagnetic

Refer also to abstracts 10818 and 10961.

10777 (CALT-68-171) STATUS AND PERSPECTIVES OF PHOTOPRODUCTION EXPERIMENTS. Heusch, Clemens A. (California Inst. of Tech., Pasadena. Synchrotron Lab.). Sept. 1968. Contract AT(11-1)-68. 155p. (CTSL-43). Dep. CFSTI.

Three lectures are presented, which deal primarily with the photoproduction of single non-strange pseudoscalar and vector mesons — data, problems, and current ideas toward their interpretation. 104 references. (L.B.S.)

10778 DOUBLE-PION ELECTRO- AND PHOTOPRODUCTION VIEWED FROM MASS-DISPERSION AND CURRENT-ALGEBRA THEORY. Dosch, H. G. (Massachusetts Inst. of Tech., Cambridge); Gordon, David. Contract AT(30-1)-2098. Ann. Phys. (N.Y.), 50: 472-99(1968).

The electro- and photoproduction of two pions off nucleons within the framework of current algebra and the new mass-dispersion relations developed by De Alfaro, Fubini, Furlan, and Rossetti are discussed. The results obtained by a one-pion reduction are compared with those obtained in earlier calculations, and the importance of dispersion corrections, not obtained thus far are pointed out. Also noted is that the proposal, suggested by some authors to obtain indirectly by means of the electroproduction process the t-dependence of the axial vector form factor, appears rather dim. Next both pions are reduced out. In the case in which the pions form an iso-singlet important dispersive corrections could be present due to a low-lying σ-meson (if it exists) and the $N_{11+}(1400)$, Roper resonance, intermediate states. Dispersive corrections which affect the amplitudes in which the pions form an iso-quintet are also discussed. The dipion production amplitudes are given for the kinematical configuration in which the pions are at rest in the Breit frame of the nucleons. (auth)

10779 PHOTOPRODUCTION OF THE η'-MESON. Achuthan, P.; Sarkar, R. N. (Indian Inst. of Tech., Madras). Nuovo Cim., 59A: 124-30(Jan. 1, 1969).

Using dispersion-theoretic techniques, calculation of the differential cross section for the η' (X^0) photoproduction is dealt with and presented. In the straight-channel, contribution from the resonance N*(1688 MeV) and in the exchange channel that from vector meson ρ (756 MeV) are included. Mixing between η and η' is used in order to estimate the coupling of the $N^*N\eta'$ vertex. (auth)

10780 PHOTOPRODUCTION OF THE ETA-MESON. Srinivasan, S. K.; Achuthan, P.; Sarkar, R. N. (Indian Inst. of Tech., Madras). Nuovo Cim., 59A: 171-80(Jan. 1, 1969).

The photoproduction of the eta-meson on protons is studied using the single integral dispersion relation. In the unitary condition, only single particles and the resonances $S_{11}(1570)$, $D_{13}(1520)$ and $F_{15}(1688)$ have been kept as intermediate states. Total and differential cross sections for various energies and angles are calculated and compared with the available experimental data. (auth)

10781 CONSISTENCY PROBLEMS IN VECTOR-MESON DOMINANCE MODELS. Zimmermann, W. (DESY, Hamburg). Nuovo Cim., 59A: 153-8(Jan. 1, 1969).

Consistency problems are discussed for models where the electromagnetic field and a neutral vector-meson field are coupled to the same current. It is shown that the conventional formulation of this model is inconsistent if the bare meson mass is infinite. However, no contradiction could be found for a different formulation of the model which is due to Kroll, Lee and Zumino. Finally a simple proof is given that the wave-function renormalization constant of the electromagnetic field is finite in this model. (auth)

10782 FORM FACTORS OF ELEMENTARY PARTICLES. Wilson, Richard (Harvard Univ., Cambridge, Mass.). Phys. Today, 22: 47-53(Jan. 1969).

The concept of form factors for measuring the charge and magnetic moment distributions in elementary particles is described. The determination of form factors for the proton, neutron, and pion from the scattering of electrons on nucleons and electron–positron colliding beam experiments are reviewed. The laboratories which have contributed and the measurements of form factors performed in them are listed. (W.H.K.)

10783 COHERENT PRODUCTION PROCESSES. Fisher, C. M. (Rutherford High Energy Lab., Chilton, Eng.). pp 235-81 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

Coherent production processes are treated according to two classes — diffraction dissociation and Coulomb dissociation mechanisms. Topics discussed include: bremsstrahlung and pair production in crystals; regeneration of neutral K_1^0 mesons, nuclear coherence properties of elementary particle reactions; Coulomb dissociation; kinematics of diffraction and Coulomb dissociation processes; Coulomb dissociation cross sections and photoproduction cross sections; and the experimental study of some coherent production processes. (L.B.S.)

10784 ELECTROMAGNETIC FORM FACTORS OF THE NUCLEON. Verganelakis, A. (Democritus Nuclear Research Center, Athens. Univ., Rome). pp 443-96 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

The kinematic structure of electron-proton elastic scattering is considered in detail. The experimental procedure used for the e-p elastic scattering studies is then discussed. The phenomenology of the e-p interaction and the introduction of the electromagnetic form factors of the nucleon is treated. The experimental determination and results are given for the proton form factors. The remaining topics deal with form factors in the timelike region, neutron form factors, electroproduction of pions, and theoretical calculations of the nucleon form factors. (L.B.S.)

10785 FIELD CURRENT IDENTITY AND THE ANOMALOUS MAGNETIC MOMENT OF THE MUON. Omote, Minoru (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 40: 1106-10(Nov. 1968).

The contribution of the hadron current to the anomalous magnetic moment of the muon is estimated by the hypothesis "Field Current Identity." The result is too small to explain the discrepancy between experimental and the theoretical values. (auth)

10786 MAGNETIC MOMENTS AND CHARGE RADII FOR STATES DESCRIBED BY AN INFINITE COMPONENT WAVE EQUATION. Nambu, Y. (Univ. of Chicago); Rosen, S. P. Progr. Theor. Phys. (Kyoto), 40: 1151-8(Nov. 1968).

General formulas for states described by a linear infinite component wave equation are derived. Specific applications of these formulas are given. (auth)

10787 ELECTROMAGNETIC FIELDS OF THE CHARGED PARTICLE PASSING THROUGH A MANY-LAYER PLATE. Garibyan, G. M.; Muradyan, M. M. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 3: 103-14(1968). (In Russian).

The electromagnetic fields arising when the charged particle passes normally through a many-layer plate composed of arbitrary number of layers of various thickness of different substances are calculated. The obtained general formula gives a possibility to calculate the radiation fields in the plate and out of it. (auth)

10788 MAGNETIC POLES AND ENERGETIC PHOTON SHOWERS IN COSMIC RAYS. Ruderman, Malvin A.; Zwanziger, Daniel (New York Univ., N. Y.). Phys. Rev. Lett., 22: 146-8 (Jan. 27, 1969).

Various anomalous high-energy pure photon showers seen in cosmic-ray emulsions are interpreted in terms of properties expected for the production of bound pole-antipole pairs. It is argued that such bound pairs are the most likely state for created monopoles. (auth)

10789 HIGH-ENERGY ELECTROPRODUCTION AND THE CONSTITUTION OF THE ELECTRIC CURRENT. Callan, C. G. Jr.; Gross, David J. (Harvard Univ., Cambridge, Mass.). Contract Nonr-1866(55) (Mod. 1). Phys. Rev. Lett., 22: 156-9 (Jan. 27, 1969).

The asymptotic behavior of electroproduction cross sections is shown to contain information about the constitution of the electric current. (auth)

10790 THE NEUTRON–PROTON MASS DIFFERENCE AND THE A2 REGGE POLE. Hara, Yasuo (Tokyo Univ.). Nucl. Phys., B8: 441-6(1968).

The size of the contribution of the Reggeized tadpole (the A2 Regge pole) to the neutron-proton mass difference $\Delta M = M_p - M_n$ is evaluated to be $\Delta M^{Regge} \approx (-0.2 \text{ to } -0.5)$ MeV. (auth)

10791 EFFECT OF ELECTROMAGNETIC CORRECTIONS TO THE STRONG INTERACTIONS ON THE NUCLEON MASS DIFFERENCE IN A RECIPROCAL BOOTSTRAP MODEL. Lichard, Peter (Katedra Fyzika SVST, Bratislava). Nucl. Phys., B8: 339-50(1968).

The p-n mass difference is calculated with an off-shell static reciprocal bootstrap model of the N and Δ(1238), developed by Biswas and Balázs. It is shown that the electromagnetic corrections to the $\Delta N\pi$ coupling constant play a crucial role for obtaining the correct sign of the nucleon mass difference. The $\Delta I = 1$ mass- and coupling constant shifts of N and Δ are calculated self-consistently. The effects of the mass splittings of exchanged and external particles are also included. The result of the present calculation $M_p - M_n = -1.8$ MeV is in rough agreement with the experimental value −1.3 MeV. (auth)

10792 LASERS AS A SOURCE AND DETECTOR OF GRAVITONS. De Sabbata, V.; Boccaletti, D.; Gval'di, Ch. (Ferrara Univ., Italy). Yadern. Fiz., 8: 924-7(Nov. 1968). (In Russian).

Various processes are studied which are related to photon and graviton interaction in external gravitational field to elucidate a possibility of generation and detection of gravitons. (auth)

Weak

Refer also to abstracts 10742 and 19783.

10793 A $\delta_\mu J_\mu$-TYPE WEAK INTERACTION AND E.T.C. TERMS IN NONLEPTONIC HYPERON DECAYS. Ohya, Katsuhiko (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 40: 1183-4(Nov. 1968).

The sum rules of amplitudes for nonleptonic hyperon decays are discussed in terms of equal-time commutators, assuming an algebra between charges and scalar or pseudoscalar mesons and using the $\delta_\mu J_\mu$ form for weak interactions. (L.B.S.)

10794 CURRENT ALGEBRA AND THE K_{e5} DECAY MODE. Intemann, Gerald William. Hoboken, N. J., Stevens Inst. of Tech., 1968. 172p.

Thesis.

From considerations of the current commutation relations of Gell-Mann and the assumption of a partially conserved axial vector current, the vector form factors for the rate K_{e5} decays are calculated. The presence of K-meson and pi-meson pole terms in certain radiative amplitudes is responsible for the complicated momentum dependence of these form factors. The decay rates for the various K_{e5} modes are evaluated and the results are compared to previous estimates based on various models. Various spectra and correlation functions in K_{e5} decay are also calculated from the current algebra results for the form factors. (Disser. Abstr.)

10795 THE SIXTH INTERACTION. II. CASE OF V-A INTERACTION. Nakagawa, Masami (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), 40: 1189-91(Nov. 1968).

A new interaction was previously proposed for elementary particles which may account for the CP violation observed in K-meson decays. The possibility is investigated that the dynamical structure of the CP violating matrix elements is the same as that of the CP conserving matrix elements, thereby allowing the CP violating effects to be calculated if only the imaginary parts of coupling constants of the new interaction are given. The case is discussed where the sixth interaction is assumed to be of the V-A type. (L.B.S.)

10796 RADIATIVE CORRECTIONS TO WEAK DECAYS. Sirlin, A. (New York Univ., N. Y.). pp 321-5 of 14th International Conference on High-Energy Physics, Vienna, 28 August-5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Two aspects of the problem of second-order radiative corrections to weak decays are discussed: corrections to the shape of the electron spectrum in beta decay and corrections to G_v/G_μ. (L.B.S.)

Strong (General)

10797 (UCSD-10-P-10-47) STRONG-INTERACTION DYNAMICS. Frazer, W. R. (California Univ., La Jolla, San Diego). Sept. 1968. Contract AT(11-1)-Gen-10. 32p. (CONF-680809-40). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

Several approaches to strong-interaction dynamics are discussed. Finite-energy sum rule bootstraps are first discussed and are applied to the $\pi\pi \to \pi\omega$ reaction. The multiperipheral bootstrap scheme is then considered. A brief discussion is given of the method and some inportant results of Gribov–Migdal diagrams for Regge poles and cuts. A few qualitative remarks on the t = 0 problem (conspiracy, Lorentz symmetry, etc.) are given. Finally, progress with the Padé approximate method of calculating scattering amplitudes is briefly reviewed. (L.B.S.)

10798 ENERGY DEPENDENCE OF TOTAL CROSS-SECTIONS IN THE CHKN MODEL. Horwitz, L. P.; Rosner, J. L. (Tel-Aviv Univ., Israel). Nuovo Cim., 59A: 237-47 (Jan. 1, 1969).

The fit to high-energy cross sections made by Cabibbo, Horwitz, Kokkedee and Ne'eman is used to predict various meson-meson, meson-baryon, baryon-baryon and baryon-antibaryon total cross sections. By correlating the energy dependence of these cross sections with the SU_3 representations allowed in the direct channel, it is found that: (i) In all channels in which resonances are expected, total cross sections decrease at least as rapidly as in channels where resonances are not expected. (ii) In baryon-antibaryon systems forming $10 + \overline{10} + 27$, total cross sections decrease more rapidly than in those forming 27 alone. (iii) Baryon-baryon total cross sections involving 1, 8 or 10 direct-channel contributions are essentially constant or increasing, while those involving only $\overline{10}$ or 27 contributions are decreasing. In particular, $\sigma_T(\Sigma^- p)$ and $\sigma_T(\Xi^- p)$ are predicted to rise by 13 and 20% respectively, in the range $5\ \text{GeV} \leq p_{lab} \leq 20\ \text{GeV/c}$. (auth)

10799 PERIPHERAL MODEL. Pilkuhn, H. (Univ. of Lund, Sweden). pp 193-233 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

Section 1 gives a brief description of peripheral collisions and pion exchange, followed by a discussion of the Chew-Low extrapolation in section 2. Next, the Born term model is discussed, including the determination of its coupling constants from resonance widths. Form factors are discussed in section 5. In section 6, the Born term model of vector meson exchange is discussed. The Stodolsky-Sakurai model is considered, which gives an accurate description of the N^* decay distribution for ρ exchange and the Y_1^* decay distribution for K^* exchange. The absorption model is discussed in section 8, which shows that the main part of the strong decrease of $d\sigma/dt$ at large values of t is due to secondary effects, namely absorption of the lower partial waves into competing channels. Experimental evidence on baryon exchange is discussed in section 9. Section 10 contains a discussion of reactions which are not of the quasi-two-particle type ab → cd, but which are extremely peripheral. Finally, in section 11, small effects of peripheral interactions on the effective mass distributions of resonances are discussed. (L.B.S.)

10800 JET ANALYSIS. Sosnowski, R. (Inst. of Nuclear Research, Warsaw); Wroblewski, A. pp 79-127 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

Some standard methods of analysis of high-energy jets observed in track detectors are presented. Methods used in the accelerator region (>30 GeV) and in the cosmic-ray region (>30 GeV) are discussed. (L.B.S.)

10801 KINEMATICS OF RESONANCE PRODUCTION. Czyzewski, O. (Inst. of Nuclear Research, Krakow). pp 129-57 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

The discussion on the kinematics of resonance production deals with three-body final states, the Chew-Low plot, and three-body subset of a larger system. (L.B.S.)

10802 CURRENT ALGEBRA. Bjorken, J. D. (Stanford Univ., Calif.); Nauenberg, M. Annu. Rev. Nucl. Sci., 18: 229-64(1968).

A brief historical review of current algebra and the PCAC hypothesis is presented. Definitions are given and the properties of currents are outlined. The topics discussed include the Goldberger–Treiman relation, Adler consistency condition, Kroll–Ruderman theorem, Adler neutrino sum rule, Cabibbo–Radicati sum rule, Ademollo–Gatto theorem, Gell-Mann–Okubo mass formula, Adler–Weisberger sum rule, photoproduction sum rules, electron and muon inelastic scattering, axial-vector coupling-constant renormalization, leptonic K decays, nonleptonic decays, Fubini–Dashen–Gell–Mann sum rule, gradient terms, Weinberg's sum rules, asymptotic sum rules, divergent radiative corrections, chiral symmetry and nonlinear effective Lagrangians. (C.E.S.)

10803 A NEW MASS FORMULA OF ELEMENTARY PARTICLES. Muraki, Yasushi (Nagoya Univ., Japan). Soryushiron Kenkyu, 38: No. 1, 34-42(Sept. 1968).

Masses of elementary particles are expressed as a logarithmic function of an integer number which represents the order of particles with increasing mass. The mass formula is interpreted in terms of the Sakata model and a fundamental force between urbaryons. (NSA of Japan)

10804 ADVANCES IN THE THEORY OF COLLISIONS AT HIGH ENERGY. Chan, Hong Mo (CERN, Geneva). pp 391-411 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Some areas of recent developments in the theory of high-energy collisions are reviewed; only the phenomenological aspects are considered. The experimental status of Regge poles is briefly summarized. Superconvergence relations, diffraction models, and unitarity corrections to Regge poles are then discussed in detail. (L.B.S.)

10805 RESONANCES: THEORY. Harari, H. (Weizmann Inst. of Science, Rehovoth, Israel. Stanford Linear Accelerator Center, Calif.). pp 195-221 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Two theoretical topics related to the interpretation of resonance states are discussed: the present status of various hadron classification schemes, and the role played by resonance states in the understanding of strong interaction dynamics. Various theoretical models are discussed for meson spectroscopy, including the quark model, Regge theory, SU(3), and chiral SU(2) × SU(2). The baryon spectrum is treated with emphasis on SU(3) and the quark model. The general question of the relation between t-channel Regge trajectories and s-channel resonances is considered. The possible mechanisms which may lead to loops in the Argand diagram for partial-wave amplitudes are discussed. The speculative picture is briefly discussed, according to which most of the observed hadron reactions may be described in terms of sums of resonance excitations. (L.B.S.)

10806 QUARK MODEL. Morpurgo, G. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). pp 225-49 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Applications of the quark model are considered in these main sections: hadron static properties and transition matrix elements; hadron classification; and collision problems. (L.B.S.)

10807 MANY-BODY PROCESSES. Czyzewski, O. (Inst. of Nuclear Research, Krakow). pp 367-87 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

A summary is presented of the papers presented at the conference and of other works on many-body processes. The general properties of many-body processes are first discussed. The remaining topics deal with the multiperipheral Reggeized model; Satz quark model; charge exchange reactions; production of antibaryons by mesons; coherent production on nuclei, angular correlations; neutral particle production; longitudinal and transverse momentum distributions for strange particles; proton-proton counter experiments; inelastic $K\pi$ interactions; isotopic spin dependence of annihilation cross section; and rare $\bar{p}d$ processes. 71 references. (L.B.S.)

Strong (Baryon No. = 0)

Refer also to abstract 10805.

10808 (LPTHE-TH-232) SPECTRAL FUNCTION SUM RULES AND MASSLESS MESONS. Capra, F. (Paris Univ., Orsay

(France). Laboratoire de Physique Theorique et Hautes Energies). Jan. 1968. 5p. Dep.

Using the asymptotic symmetry approach of Das, Mathur and Okubo, it is shown that Weinberg's second spectral function sum rule and its generalization to $SU_3 \otimes SU_3$ can be derived in a consistent way only in the limit of massless spin zero mesons. This limit has to be kept in all applications of the sum rule, in particular in the calculation of the pion mass difference. (auth)

10809 ANALYSIS OF INTERFERING RESONANCES. Fischer, W. E. (CERN, Geneva. Eidgenoessiche Technische Hochschule, Zurich). Nuovo Cim., 59A: 29-39(Jan. 1, 1969).

A spin-density matrix for two interfering resonances is defined. A momentum analysis of the decay distribution of this mixed system enables us to determine the real spin configuration of these resonances. The relative phase between the two amplitudes can also be extracted. (auth)

10810 PION–PION PHASE-SHIFT INFORMATION FROM THE REACTION $\bar{p}p \to 3\pi$. Hopkinson, J. F. L.; Roberts, R. G. (CERN, Geneva). Nuovo Cim., 59A: 181-98(Jan. 1, 1969).

The relativistic forms of the Faddeev equations are studied in connection with any general decay process into three pions. The pion-pion interaction is parametrized through off-shell form factors for each partial wave to the relevant phase shifts. The equations are solved numerically for the case of $\bar{p}p \to 3\pi$, where the annihilation is at rest, and compared with experimental data for the Dalitz plot for the $\pi^+\pi^-\pi^0$ final state. Phase-shift solutions for the P and D waves are fed in which simply correspond to the ρ and f^0 mesons and the best fits from a wide-ranging set of solutions of the S-wave phase shifts are found. Evidence is found in favor of an S-wave resonance close to the ρ mass with a corresponding width of 480 MeV. (auth)

10811 DETERMINATION OF THE MIXING ANGLE BETWEEN THE KAONS WITH $J_P = 1^+$. Fourez, G.; Oneda, S. (Univ. of Maryland, College Park). Nuovo Cim., 59A: 65-70(Jan. 1, 1969).

Using chiral $SU_3 \times SU_3$ charge algebra, a formula for the mixing angle for the kaons with $J_P = 1^+$ is derived. The formula depends only on the masses of $I = 1$ and $I = \frac{1}{2}$, 1^+ and 1^- mesons. Comparison with the quark model is made. (auth)

10812 REGGE POLES IN THE $Y\bar{N}$ CHANNEL AND THEIR PROPERTIES IN THE ZERO-ENERGY LIMIT. Morita, Katsusada (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 40: 1087-1105(Nov. 1968).

The zero-energy properties of strange-meson Regge poles are investigated in terms of a study of conspiracy relation for the reaction $Y + \bar{N} \to Y + \bar{N}$ (Y is a hyperon). The difference between conspiracies of nonstrange- and strange-meson Regge poles is then clarified. Phenomenological implication of a parity doublet conspiracy in meson-baryon scatterings is also discussed. (auth)

10813 A PROOF OF THE EXISTENCE OF FUNCTIONS THAT SATISFY EXACTLY BOTH CROSSING AND UNITARITY. II. CHARGED PIONS. NO SUBTRACTIONS. Atkinson, D. Nucl. Phys., B8: 377-90(1968).

The contraction mapping principle is used to show that there exist pion-pion scattering amplitudes that satisfy the Mandelstam representation with full crossing symmetry between the three channels, elastic unitarity between the elastic and inelastic thresholds, and the inelastic unitarity inequalities above the latter. (auth)

10814 $\pi-\pi$ PARAMETERS AND SUM RULES AT THE SYMMETRY POINT. Tryon, E. P. (Columbia Univ., New York). Phys. Rev. Lett., 22: 110-13(Jan. 20, 1969).

It is shown that the current-algebra predictions of Weinberg for $\pi-\pi$ scattering may be consistent with the sum rules proposed by Chu and Desai, who have claimed otherwise. It is demonstrated that high-spin resonances neglected by Chu and Desai can make substantial contributions to the sum rules, and that inclusion of the next resonance after those used by Chu and Desai results in agreement between Weinberg's predictions and the sum rules. It is possible and likely that the remaining high-spin resonances give negligible net contribution. (auth)

10815 THE PION–PION AND NUCLEON–ANTINUCLEON VERTEX FOR A MESON RESONANCE OF ARBITRARY SPIN. Schiller, D. H. (Univ., Bucharest). Rev. Roum. Phys., 13: 571-8(1968).

The general expressions are given through form factors of the $\pi\pi-M^j$ and $N\bar{N}-M^j$ vertices, for meson resonances M^j of mass $M \neq 0$ and arbitrary spin j, described by tensor fields. The contribution of the exchange diagram to the total and partial wave amplitudes is evaluated for the $\pi\pi \to \pi\pi$ and $\pi\pi \to N\bar{N}$ processes. (auth)

10816 CURRENT ALGEBRA. Weinberg, S. (Massachusetts Inst. of Tech., Cambridge). pp 253-78 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

A general survey is first given of recent developments in current algebra. Some new techniques for deriving results from chiral symmetry are discussed. Several topics are considered in detail. Saturated sum rules for forward scattering of pions are considered in section 2. Section 3 discusses $\pi-\pi$ scattering lengths. The algebra of fields is described in section 4 and is used to derive the spectral function sum rules. Hard pion calculations are considered in section 5. Section 6 deals with SU(3) × SU(3) breaking, for k mesons and k_{13} decay. (L.B.S.)

10817 TWO-BODY PROCESSES. Bellettini, G. (Univ., Pisa, Italy. Istituto Nazionale de Fisica Nucleare, Pisa, Italy). pp 329-64 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

Experimental data on two-body processes are reviewed. These include elastic scattering and total cross sections; charge exchange; polarization effects; inelastic two-body collisions in pp interactions; and inelastic two-body collisions in meson-nucleon scattering. 127 references. (L.B.S.)

Strong (Baryon No. = 1)

Refer also to abstracts 10805, 10812, 10817, 10829, 10951, and 11056.

10818 NUCLEON AXIAL VECTOR FORM FACTOR. Yu, Victor Kien-chung. College Park, Md., Univ. of Maryland, 1968. 60p.

Thesis.

It has been shown by Woo in a derivation of the nucleon axial vector form factor, using the multichannel N/D method, approximating the $I = 1$, $J = 1$, parity +, 3π intermediate state, that this gives insufficient contribution to explain the momentum transfer dependence of the form factor. The possibility of the recently reported $J = 1$, $I = 1$, parity +, πp resonance A_1 with mass 1080 MeV, width 130 MeV contributing to the form factor is considered. This gives significantly better agreement with experiment but leaves room for other possible contributions. Contributions from scalar mesons are also studied. Various schemes suggesting scalar mesons have been considered. Some of the parameters proposed, i.e., a narrow width 500 MeV scalar meson and a 700 MeV scalar meson with relatively large width are applied. It is shown that the inclusion of the pion scalar dipion intermediate states will improve agreement with experiment. (Disser. Abstr.)

10819 HIGH-ENERGY $\pi^\pm$–p AND $K^\pm$–p SCATTERING AND THE COMPLEX GAUSSIAN POTENTIAL. Saifuddin (Univ. of Islamabad, Pakistan). Nuovo Cim., 59A: 9-19(Jan. 1, 1969).

The $\pi^\pm$-p and $K^\pm$-p elastic differential cross sections at high energies (>8 GeV) are analyzed in terms of a complex potential of the Gaussian form. The fits are obtained up to the momentum transfer $-t = 2$ $(\pm eV/c)^2$ for $\pi^\pm$-p scattering and up to $-t = 1.2$ $(GeV/c)^2$ for $K^\pm$-p scattering. It is found that the inverse range of the "soft" core remains constant around 0.355 GeV for all these processes. The energy-dependence for high energy hadron-hadron elastic scattering is discussed. (auth)

10820 MULTICHANNEL POTENTIAL MODEL OF πN SCATTERING IN THE $I = \frac{1}{2}$, $J = \frac{1}{2}^+$ STATE. Sheth, B. I.; Tubis, A. (Purdue Univ., Lafayette, Ind.). Nuovo Cim., 59A: 159-70(Jan. 1, 1969).

A multichannel-potential model, which incorporates some relativistic kinematics, correct threshold behaviors, space-time symmetries and coupling to channels containing unstable particles is developed. The model is a generalization of the separable-potential model of Yamaguchi. It is applied to πN scattering in the $I = \frac{1}{2}$, $J = \frac{1}{2}^+$ state. The πN and σN (where σ is an unstable $I = 0$, $J = 0^+$ two-pion state) channels are taken into account. The parameters of the model are adjusted to give 1) a nucleon bound state at the physical nucleon mass, 2) a zero in the πN amplitude at a pion laboratory kinetic energy of 150 MeV, 3) the πN Roper resonance at a pion laboratory kinetic energy of 600 MeV and 4) the experimental inelasticity parameter. The πN coupling constant $g_\pi^2/4\pi = 15.2$ and the πN $I = \frac{1}{2}$, $J = \frac{1}{2}^+$ scattering length $a_{11} = -0.06$ in units of the cube of the pion Compton wavelength are found in fair agreement with the experimental values $g_\pi^2/4\pi = 15.1 \pm 0.006$ and $a_{11} =$

-0.101 ± 0.007, respectively. The σN coupling constant $g_\sigma^2/4\pi$ was found to be ~7 in comparison with estimates of ~4 + 5 from the analysis of nucleon-nucleon scattering. (auth)

10821 MULTI-RESONANCE STRUCTURE IN THE P_{11} STATE OF πN SCATTERING. Uehara, Masayuki (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto), 40: 1060-7(Nov. 1968).

The multi-resonance structure in the P_{11} partial wave amplitude of πN scattering below 2 GeV is analysed by a multi-step parametrization of resonances. In each step the amplitudes satisfy the unitarity strictly but not necessarily the analyticity. It is shown that the experimental values given by the CERN group are fitted fairly well by the third step amplitude which includes the nucleon, the first Roper resonance (~1370 MeV) and the second Roper resonance (~1740 MeV). The similar structure seen in other dominant nucleon resonances is also discussed. (auth)

10822 DECAY MODES OF HIGHER RESONANCES. Kinoshita, Kisei (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto), 40: 1187-9(Nov. 1968).

Speculations are made concerning the partial resonance widths belonging to Δ_δ, Σ_δ, and N_γ recurrences decaying into a pseudoscalar meson plus a baryon with $J^P = 1/2^+, 5/2^+, 3/2^+ \ldots$. Results of calculations for the decays are tabulated. (L.B.S.)

10823 REGGE-POLE ABSORPTION MODEL FOR πN CHARGE EXCHANGE AND CROSS-OVER. Michael, C. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys., B8: 431-440(1968).

πN finite-energy sum rules, together with charge-exchange differential cross sections and polarization data are used to test the predictions of the absorptive corrections to Regge ρ exchange. An improved description is found, and a comparison is made of the modifications resulting from absorptive corrections with those from an additional ρ' Regge pole. An analysis of the cross-over and sense-nonsense zeroes in the amplitudes is presented, and the implications for factorization are discussed. (auth)

10824 REGGE-POLE ANALYSIS FOR π^- PRODUCTION OF ρ^- MESON NEAR THE BACKWARD DIRECTION. Shih, C. C. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett., 22: 105-8(Jan. 20, 1969).

ρ^- production near backward direction has been analyzed in a Regge-pole model with the emphasis on kinematic structures and constraint relations. Results are obtained which agree well with experimental data and are consistent with backward elastic scattering. (auth)

10825 RESONANCE SOLUTIONS OF EQUATIONS FOR THE πN SCATTERING. Lend'el, V. I.; Marina, D. M. (Uzhgorod State Univ., USSR). Yadern. Fiz., 8: 1044-51(Nov. 1968). (In Russian).

Resonance solutions of dispersion equations for the p_{11} and p_{33} partial waves are obtained. Taking into account the short-wave interaction one can get rid of cut-off in the dispersion integrals. A possibility to interpret the nucleon as a bound state of the πN system is considered. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 10817.

10826 N–N* INTERACTIONS WITH FADDEEV EQUATIONS. Gale, William Arthur. Houston, Tex., Rice Univ., 1968. 134p. Thesis.

The problem of whether a two nucleon bound state or resonance can arise dynamically from the Peierls mechanism — the exchange of a real pion by two nucleons having a resonant interaction with the pion is discussed. A number of low partial waves of the nucleon-nucleon-pion system are examined to determine in which states the resonant pion exchange mechanism gives rise to significant attractive forces with the possibility of creating a bound state or resonance. The principal tool is the nonrelativistic Faddeev equation incorporating isospin and spin. A relativistic extension of the Faddeev equations due to Lovelace is also used. The pion-nucleon interaction is represented by a separable potential, but the sensitivity of the results to the exact form of this interaction is investigated. The principal result for the NN_π system is that there will be no bound states and two broad resonances with isospin two indicated at an energy about 450 MeV above the nucleon–nucleon threshold. Spinless bosons of the nucleon mass would have a bound state in a nonrelativistic model. Several extensions of this work that are possible are discussed. (Diss. Abstr.)

10827 INFLUENCE OF THE TRANSVERSE MOMENTUM OF THE FIREBALLS ON THE ANGULAR DISTRIBUTION OF PRODUCED PARTICLES IN HIGH-ENERGY COLLISIONS. Agnese, A.; La Camera, M.; Wataghin, A. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cim., 59A: 71-80(Jan. 1, 1969).

A general formula is obtained for the angular distribution of produced particles in k-fireball model ($k \geq 2$) which includes as parameters, besides the usual γ_c and γ_{b_i}, also the angle of emission $\bar{\alpha}_i$ of the i-th fireball in the c.m.s. relative to the direction of the colliding particles ($0 \leq \bar{\alpha}_i \leq \pi$). With the use of that formula complete account may be taken of an eventual finite transverse momentum of each fireball. This is shown to be already useful in treating asymmetric cases of particle-particle collisions. The formula will be especially useful in cases when γ_c is known or in treating antiparticle-particle annihilation in flight. In those cases it may be used as a step toward a dynamical theory. (auth)

10828 COVARIANT O_4 PROPAGATORS AND TOLLER POLES. Jones, H. F. (Imperial Coll. of Science and Tech., London). Nuovo Cim., 59A: 81-91(Jan. 1, 1969).

A calculus of O_4 propagators is developed which leads to a covariant formulation of the theory of Toller poles. The reduction of these poles to Regge poles is demonstrated within the formalism for forward NN scattering. Possible extensions to $t \neq 0$ and/or unequal-mass scattering are discussed. (auth)

10829 HYBRID MODEL: FURTHER RESULTS. Chiu, C. B.; Finkelstein, J. (CERN, Geneva). Nuovo Cim., 59A: 92-106 (Jan. 1, 1969).

In a previous paper a "hybrid" model was proposed for the large-energy, small-angle elastic scattering of hadrons, and used to understand the structure in the angular distributions of proton-proton and proton-antiproton differential cross sections. This model describes the scattering amplitude as the sum of an optical diffractive piece and a piece arising from the exchange of "absorbed" Regge poles; alternatively, it can be viewed as a specific prescription for calculating the effects of Regge cuts. In the present paper, some further results obtained from this hybrid model are presented: the solutions for the pp amplitude are extrapolated to higher energies. It is shown how the model may be extended to deal with inelastic (or backward elastic) scattering, and processes are considered which cannot be described by the single exchange of any known Regge trajectory, such as K^-p backward elastic scattering. It is explained why Regge cuts do not affect the presence or location of the dip in the π^+p near-backward differential cross section which is thought to arise from a nonsense zero of the nucleon trajectory. It is predicted that the differential cross sections of elastic and of inelastic reactions should have the same t-dependence at large $|t|$, whether or not they do at small $|t|$. (auth)

10830 CALCULATION OF THE N–N PHASE SHIFTS TAKING INTO ACCOUNT EXCITED STATES OF THE NUCLEONS. Wagner, S. (Univ., Hamburg); Winiger, P. Helv. Phys. Acta, 42: 51-62 (Feb. 15, 1969).

Elastic N–N phase-shifts are calculated using the strong-coupling potential derived by Fierz who employed the fixed source PS–PS meson theory of Wentzel. In the limit of strong coupling, isobaric states of the nucleon appear, and consequently the N–N interaction has to be treated as a multichannel problem. Using the experimental values of the renormalized pion coupling constant and of the $N_{\frac{3}{2}}$ resonance energy, a hardcore of about 0.5 fermi is introduced as the only phenomenological parameter. The multichannel Schrödinger equation is solved for positive energies. As a result of the calculations the correct energy dependence of the two S-wave phase-shifts at intermediate energies is obtained. All D-wave phase-shifts check with the experimental values up to 100 MeV; for higher energies the computed phase shifts are too large. For high values of angular momentum they tend to OPEC phase shifts; here all phase shifts with $J \geq 3$ are in agreement with experiment. But for most of the intermediate odd phase shifts there occurs the same kind of disagreement that is known from perturbation theory, when no vector mesons and no spin-orbit potential are introduced into the theory. (auth)

10831 PRODUCTION OF HYPERNUCLEI WITH STRANGENESS S = –2. Bechdolff, Alfred; Baumann, Germain; Gerber, Jean-Paul (Centre de Recherches Nucleaires, Strasbourg. Faculte des Sciences, Nancy). Compt. Rend., Ser. A and B, 267: 978-80(Oct. 28, 1968). (In French).

The characteristics of four events with double emission of hyperfragments were compared with the emission by an intermediary ΞZ hypernuclei nuclear cascade process. (tr-auth)

10832 REGGE-POLE MODEL FOR THE INVARIANT FUNCTIONS OF THE NUCLEON–NUCLEON AND MESON–NUCLEON SCATTERING. Muetter, K. H. (Freie Univ., Berlin). Nucl. Phys., B8: 311-25(1968).

Unlike Toller poles, Regge type poles in the invariant functions of the nucleon-nucleon and meson-nucleon scattering produce finite conspiracy families which have the remarkable property that the residues of the parent and daughter trajectories automatically satisfy the factorization hypothesis. Possible interpretations of these families in terms of known resonances are discussed as well as consequences for the high energy behaviour of the nucleon-nucleon and meson-nucleon scattering. (auth)

Particle Invariance Principles and Symmetries

General

10833 BROKEN SYMMETRY AND THE SMUSHKEVICH PRINCIPLE. Narayanaswamy, P.; Santhanam, T. S. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., 59A: 20-8(Jan. 1, 1969).

An attempt is made to incorporate broken SU_2 symmetry of the isospin in a dynamical scheme based on the Smushkevich principle. It is found that a unique solution to the problem is possible only if conservation of electric charge is assumed, resulting in a simple sum rule for the physical pion-nucleon coupling constants. The possibility of extending this method to higher symmetries is discussed. (auth)

10834 APPLICATIONS OF INVARIANCE PRINCIPLES IN THE PHYSICS OF ELEMENTARY PARTICLES. Nguyen-Khac, U. (Ecole Polytechnique, Paris); Six, J. pp 283-334 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

An attempt is made to define the different known invariances as precisely as possible and, in particular, to draw from them the practical consequences for the reactions of elementary particles. The first chapter deals with general laws valid for all interactions—space-time conservation laws, laws associated with Fermi statistics and with Bose–Einstein statistics, and gauge invariance. The next chapter discusses the laws valid only for strong and electromagnetic interactions: C, P, T invariances. Laws valid only for strong interactions are discussed in chapter III: charge independence, charge symmetry, and isotopic parity. Particular rules for weak interaction are treated in chapter IV. The last chapter presents applications of the selection rules in the case of strong and electromagnetic interactions. (L.B.S.)

10835 PROOF OF THE FACTORIZABILITY THEOREM CONJECTURED BY SCIARRINO AND TOLLER. Nakanishi, Noboru (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 40: 1137-42(Nov. 1968).

A general proof of a symmetry property of the residues of the transformation function between irreducible representations of SU(2) and SU(1,1) which is encountered in the decomposition of the principal series of the SL(2,C) functions is presented. (auth)

10836 ON THE GENERALIZATION OF CANONICAL COMMUTATION RELATIONS WITH RESPECT TO THE ORTHOGONAL GROUP IN EVEN DIMENSIONS. Geyer, B. (Karl-Marx Univ., Leipzig). Nucl. Phys., B8: 326-32(1968).

A method is proposed to obtain a set of commutation relations for creation and annihilation operators. This method has to do with the Lie algebra of the orthogonal group of even dimensions. It is shown that the irreducible representations with unique vacuum state lead to the well-known para-Fermi commutation rules. A conjecture is made that this conclusion holds also for other proposals to quantize by means of commutation rules which are related to the orthogonal group in even dimensions. (auth)

10837 ORIGIN OF REGGE SYMMETRY FOR WIGNER COEFFICIENTS OF SU(2). Kramer, P.; Seligman, T. H. (Univ., Tuebingen, Ger.). Z. Phys., 219: 105-13(1969).

Using general properties of the representations of unitary groups and their relations to representations of symmetric groups, the 3j symbol of the unitary unimodular group $\mathcal{U}(2)$ is written in terms of a 9j symbol of the unitary unimodular group $\mathcal{U}(J)$ with J being the sum of the three j's. The result yields the Regge symmetry of the 3j symbol as a consequence of new relations between Wigner coefficients and special invariants of unitary groups on one hand and the association symmetry of the symmetric group on the other. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 10745.

10838 (UCRL-18369) COMPARISON OF π^+ AND π^- LIFETIMES AS A TEST OF CPT INVARIANCE. Ayres, David S. (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1, 1968. Contract W-7405-eng-48. 151p. Dep. CFSTI.

One of the consequences of the CPT theorem is the prediction that a particle and its antiparticle will have equal lifetimes. The experiment described here tests that prediction by comparing the mean lifetimes of π^+ and its antiparticle π^-. The result of the measurement was $\tau_{\pi^+}/\tau_{\pi^-} = 1.00055 \pm 0.00071$, which is consistent with the prediction of the CPT theorem. The experimental method was to measure the fraction of surviving pions at several positions along a 35-ft (one-half lifetime) decay path. The beam polarity was alternated frequently between positive and negative particles, and many precautions were taken to ensure that the π^+ and π^- beams were identical in their spatial and momentum distributions. Most of the running time was spent investigating possible sources of systematic bias which might make the lifetimes appear to be different, and a number of these systematic errors were found and eliminated. (auth)

10839 UNITARY SYMMETRY AND WEAK INTERACTIONS. Gaillard, M. K. (Labortoire de Physique Theorique et Hautes Energies, Orsay, France). pp 383-425 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

The elements of SU(3) are discussed in detail. The leptonic decays of strongly interacting particles are discussed in terms of the current-current theory and universality, the Cabibbo theory, nonrenormalization theorem, axial vector coupling constants and the Goldberger–Treiman relation, induced form factors, and current algebra. Two dynamic approaches are outlined for calculating weak nonleptonic decay amplitudes—the bootstrap method and the current algebra method. (L.B.S.)

10840 EXPERIMENTS FOR THE VERIFICATION OF CP AND T INVARIANCE. Gaillard, J. M. (CERN, Geneva). pp 335-81 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

The first chapter is devoted to a general review of the K_1^0–K_2^0 system, and to a discussion of the various experimental results on K^0 decay and regeneration before the discovery of CP violation. In the second chapter, the experimental evidence for CP violation in K_2^0 decays, and the experiments which are performed on the K_1^0–K_2^0 system for further investigation of the violation are discussed. The last chapter contains a brief resume of the various theories which have been proposed to account for the CP violating effects. Some of the experimental consequences of these theories which are already being tested are also discussed. (L.B.S.)

10841 BROKEN MIRROR (V +- A) SYMMETRY OF WEAK INTERACTIONS OF ELEMENTARY PARTICLES AND THE PROPERTIES OF NEUTRINO. Lipmanov, E. M. (Volgograd Pedagogical Inst., USSR). Zh. Eksp. Teor. Fiz., 55: 2245-51(Dec. 1968). (In Russian).

A new approach to understanding nonconservation of parity in weak interactions of elementary particles is proposed which consists in regarding it as a manifestation of broken mirror ($V \mp A$) symmetry and which can totally or partially be restored in the limit of large invariant transferred momenta. Restoration of symmetry is explicitly realized in the model with intermediate vector bosons in the region of applicability of perturbation theory. Possible experimental manifestations of violated ($V \mp A$) symmetry and of various assumptions concerning the nature of the neutrino are discussed. (auth)

10842 CPT NONCONSERVATION AND PAIR-CONJUGATE BOSONS. Kitani, Kohei (Tokyo Inst. of Tech.). Progr. Theor. Phys. (Kyoto), 40: 1131-6(Nov. 1968).

It is pointed out that there are two kinds of fields to describe spinless bosons of a pair-conjugate multiplet and that these two kinds of fields are connected nonlocally with one another and are transformed differently under the CPT transformation in the case of half-integer isospin. From this result a new model for the 2π decay of the long lived neutral K meson is proposed; the observed CP violation is due to CPT violating and yet Lorentz-invariant interaction. (auth)

10843 WEAK INTERACTIONS AND CP VIOLATION: THEORETICAL. Treiman, S. B. (Princeton Univ., N. J.). pp 307-21 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.

See CONF-680809.

A review is given of the theoretical discussions presented at the conference on CP violation and weak interactions. The discussion

deals with conventional weak interaction theory, in connection with the application of current algebra and its generalizations to K_{l3} decay. Various models for higher-order weak interactions are also discussed. (L.B.S.)

Applications (Strong)

10844 THE O(4) SYMMETRY AND THE EFFECTS OF PARTICLE MIXING. Nakamura, Seitaro (Tokyo Univ. Nihon Univ., Tokyo); Sato, Hikaru; Sato, Shigeo. Progr. Theor. Phys. (Kyoto), 40: 1111-24(Nov. 1968).

In terms of the O(4) symmetry, the strong decay of $\phi \to \rho\pi$, $K\bar{K}$ and the weak decay of $\Xi \to \Lambda\pi$, $\Lambda \to \pi N$ are studied by taking into account the particle mixing arising from a contribution of the symmetry breaking interaction. A selection rule on G'-parity, (parity for a new kind of an extended charge conjugation) is successfully applied to the strong decay of mesons 1^- and 2^+. The observed decay modes of the G'-parity-violating transitions are attributed to the effects of the symmetry breaking interaction and the particle mixing. (auth)

10845 POTENTIAL MODEL OF SU(3)-SYMMETRY BREAKING FOR MESONS. Khalil, Ahmad B (Oxford Univ.). Nucl. Phys., B8: 460-70(1968).

This is an investigation in a simple model of dynamically produced deviations from unitary symmetry. A potential analogue of a bootstrap model of vector mesons is used: the vector meson octet is treated as bound state of two pseudoscalar meson octets, the latter being bound by a vector-meson octet exchange. An approximate bootstrap solution is first obtained for the mass of degenerate vector mesons and their SU(3)-invariant coupling to degenerate pseudoscalar mesons. The mass splitting within the pseudoscalar meson octet is then considered as an input. The effects of mass splitting within the exchanged vector-meson octet and the deviations from their SU(3)-symmetric values of the coupling constants of the exchanged vector mesons to the pseudoscalar mesons are studied. It is found that the direct effect of the splitting of the exchanged mass on the bound-state mass is small; however its sign cannot be determined by naive considerations and is model dependent. It is found also that the effects of the deviations in the coupling constants cannot be ignored. (auth)

Field Theories

General

10846 GAUGE FIELDS WITH NONINVARIANT INTERACTIONS. Fitzgerald, Raymond. New York, City Univ. of New York, 1968. 67p.

Thesis.

Gauge fields interacting with source fields in a gauge-noninvariant way are examined in a purely classical framework. The existence of conserved currents for the solutions of such theories follows from the properties of the free gauge fields rather than from the usual requirement of global gauge covariance. Gauge-noninvariant interactions for Einstein's theory of gravitation are presented in which the properties of the sources are carried by the metric field. In the case of the Yang-Mills field, internal symmetries for a real scalar source field are a consequence of the properties of the gauge field. One of the simplest gauge noninvariant theories of electromagnetism is shown to be an extension of Dirac's theory of classical clouds of charge. In this extension the clouds exhibit some quantum features. Self interactions are eliminated from the classical gauge noncovariant theory by employing the formalism of attached fields. For single particles without spin the solutions of the classical theory are then equivalent to the quantum wave function solutions which have integrable phase gradients. A necessary condition for the existence of a physically significant nonintegrable phase gradient in the quantum theory is derived. For time independent solutions the single valuedness requirement for the quantum wave function is equivalent to the introduction into the classical theory of the singular magnetic filaments which arise from quantized Dirac magnetic monopoles. A uniform external distribution of charge is shown to produce a static configuration for the minimum wave packet. (Diss. Abstr.)

Quantum Field Theory

Refer also to abstracts 10739 and 10772.

10847 RELATIVISTIC INTEGRAL EQUATIONS WITH COMPACT OPERATOR. I. Greenman, J. V. (Univ. of Essex, Colchester, Eng.). Nuovo Cim., 58B: 421-40(Dec. 11, 1968).

It is proved that the integral operator of the Bethe–Salpeter equation for the three-point function in a single-mass φ^3 boson theory in the ladder approximation is compact for all values of total energy. (auth)

10848 CONVERGENCE OF REGULARIZED, RENORMALIZED PERTURBATION SERIES FOR SUPER-RENORMALIZABLE FIELD THEORIES. Simon, B. (Princeton Univ., N. J.). Nuovo Cim., 59A: 199-214(Jan. 1, 1969).

It is shown for the two-dimensional scalar Yukawa interaction, that the renormalized perturbation series has at least a finite radius of convergence when regularized (cut-off in space-time and momentum space). This is accomplished by writing down the explicit renormalized series, studying some of its associated combinatorics, and applying Caianiello's standard arguments on the unrenormalized series. The result extends to any super-renormalizable theory of the $\varphi\bar{\psi}\psi$ form. (auth)

10849 DAUGHTER REGGE TRAJECTORY IN THE BETHE-SALPETER EQUATION. Fontannaz, M. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cim., 59A: 215-36(Jan. 1, 1969).

The Bethe–Salpeter equation is solved in the ladder approximation of the $\lambda\Phi^3$ theory by the Fredholm method. An implicit equation for the Regge trajectories is obtained by putting the Fredholm determinant equal to zero. In the weak-coupling limit the following results are obtained: a) Equal-mass case: The first daughter trajectory is horizontal to first order in the coupling constant and the residue of the pole vanishes to all orders of the coupling constant. b) Unequal-mass case: At $s = 0$, the slope of the daughter is positive and smaller than that of the mother if the relative mass difference $(m^2-\mu^2)/\mu^2 = x$ is not too great. It becomes negative when x increases. The residue of the pole has the characteristic behavior in $(m^2-\mu^2)^2/s$ for s close to zero. Two other trajectories are also found, the slope of one of them is negative for certain values of the masses. (auth)

10850 ON THE SCALAR FIELD MODEL. Guenin, Marcel (Univ., Geneva); Velo, Giorgio Helv. Phys. Acta, 42: 102-116 (Feb. 15, 1969).

The scalar field model is studied on a mathematically rigorous basis. Using algebraic techniques, the explicit cut-off dependent operator solution is obtained, and the existence of the limit whenever the cut-off is removed is discussed. It is shown that the Wightman functions are tempered distributions in the limit of no cut-off and in a space with dimension less or equal to three. (auth)

10851 A NOTE ON THE COMMUTATION RELATIONS OF FIELD OPERATORS. Schneider, Walter (Imperial Coll. of Science and Tech., London). Helv. Phys. Acta, 42: 201-3(Feb. 15, 1969).

Let $\phi(.)$ and $\psi(.)$ be two fields transforming according to finite irreducible representations of SL(2,C). Then the (anti-) commuting of two properly chosen components of $\phi(x)$ and $\psi(y)$, (x,y) varying in a domain $G \subset R^4 \times R^4$, implies the vanishing of all (anti-) commutators between any component of $\phi(x)$ and $\psi(y)$, respectively. (auth)

10852 THEORY OF FIELDS IN FINSLER SPACES. I. Takano, Yoshiro (Yokohama National Univ., Japan). Progr. Theor. Phys. (Kyoto), 40: 1159-80(Nov. 1968).

The theory of fields in Finsler spaces, where the fields have internal freedom, is developed. In particular, the spinor field is discussed in detail and it is found necessary to introduce the gauge fields into the equation of the spinor field. The generalizations of Finsler spaces are also attempted. (auth)

10853 CONVERGENT FIELD THEORY WITH NON-LINEAR NON-LOCAL INTERACTION. Yamamoto, Hiroshi (Fukui Univ., Japan). Progr. Theor. Phys. (Kyoto), 40: 1143-50(Nov. 1968).

The Lagrangian formalism of nonlinear field theory is criticized, and its weak points are summarized. To improve these points a nonlinear and nonlocal interaction is introduced. It is shown that construction of a divergence-free theory is possible, and there is no difficulty of negative norm in the theory. The theory can describe the same contents as the usual quantum electrodynamics. If the self-generating method is applied, the physical mass of the electron and the effective coupling constant can remain finite, even though the mechanical mass and coupling constant tend to zero. (auth)

10854 PARAMETRIC REPRESENTATIONS OF RENORMALIZED FEYNMAN AMPLITUDES. Appelquist, Thomas William. Ithaca, N. Y., Cornell Univ., 1968. 93p.

Thesis.

A formulation of renormalization theory using parametric integral representations of Feynman amplitudes was investigated. The purpose of the work was to develop an approach to renormalization theory which would avoid some of the usual complexities such as the overlap problem and questions of uniqueness and which would provide a general framework for carrying out higher order calculations in quantum electrodynamics. A parametric integral form for arbitrary unrenormalized Feynman amplitudes was first established. Using this form as a starting point, a prescription was given for forming the corresponding renormalized amplitude by making use of the well-known formula for the remainder of a Taylor series. This led to a nonrecursive definition of renormalized amplitudes which was explicitly independent of the choice of integration momenta and of the routing of external momenta through the corresponding graph. This parametric integral form for renormalized amplitudes was shown to be absolutely convergent and its equivalence with the usual recursive subtraction formula which gives rise to mass and coupling constant renormalization was demonstrated for the case of a self-coupled field with the ϕ^4 interaction. (Diss. Abstr.)

10855 FINITE FORMULATION OF QUANTUM ELECTRODYNAMICS. Eoll, C. K. (International Centre for Theoretical Physics, Trieste, Italy). Can. J. Phys., 47: 153-9(Jan. 15, 1969).

A recent finite formulation of field theory is applied to quantum electrodynamics. The basic assumptions of the formulation are Bogoliubov causality and TCP invariance of the S-operator; interpolating fields are never used. Ultraviolet divergences never appear in the calculations, and there is manifest Lorentz covariance at every stage. In particular, the calculation of the proper third-order vertex is carried through. (auth)

Gravitation and General Relativity

Refer also to abstracts 10426 and 10792.

10856 FIELD EQUATIONS OF GENERAL RELATIVITY. Gliner, E. B. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 55: 2334-44(Dec. 1968). (In Russian).

Equations are derived which are expressed in terms of fourth rank tensors and relate geometric quantities characterizing space—time with the local properties of matter and vacuum. The equations are derived by a variational method which is a generalization of the method based on the Palatini Lagrangian. The equations do not transcend the general theory of relativity and are naturally related to its logical structure. They are field equations of general relativity theory which are more general than the Einstein equations in that respect, that they are consistent with the possibility of local interaction between matter and a gravitational field (vacuum). The equations can be employed as a basis of the theory of gravitational radiation and in those astrophysical problems in which local interaction with the gravitational field affects the properties and structure of matter. In distinction to the Einstein equations the present ones indicate that a substantial nature can be ascribed to vacuum and the latter (together with matter) can be regarded as the carrier of space—time properties. (auth)

Scattering Theory

Refer also to abstracts 10930, 11051, and 11056.

10857 (JINR-P4-4099) ON POSSIBILITY OF USING DIRECT METHODS IN SCATTERING PROBLEMS. Efimenko, T. G.; Zhigunov, V. P.; Zakhar'ev, B. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 16p. (In Russian). Dep.

The Ritz, Bubnov–Galerkin and the least-squares methods are formulated for the scattering problem. Convergence of the sequential approximations to the precise solution and stability of the numerical solution with respect to the error in calculations, are discussed. The known difficulty of the Koon variation method, i.e., appearing of non-physical singularities in the energy dependence of the scattering amplitude, is analyzed. The simple ways to overcome this difficulty are pointed out. The reactions with the particle rearrangement are considered. (auth)

10858 (NYO-3829-26) ON THE COVARIANCE AND ANALYTICITY OF SCATTERING AMPLITUDES. Seiler, R. (Pittsburgh Univ., Pa.). Oct. 1968. Contract AT(30-1)-3829. 35p. Dep. CFSTI.

The problem of analytic extensions of real analytic functions into complex domain, invariant under the action of complex Lorentz transformations with determinant one, is analyzed for the discussion of crossing and CPT symmetries in the S-matrix approach to scattering. The first lecture deals with geometries in a linear space and the corresponding symmetry groups. The second lecture contains a brief survey of the representation theory of the real Lorentz group. Restrictions and extensions of spinor representations are considered. The last lecture starts with an exposition of the CPT theorem in field theory. Only the parts necessary for the comparison with the analog problem in analytic S-matrix theory are considered. Finally, the analytic extensions of real analytic scattering amplitudes are analyzed. (L.B.S.)

10859 CONTINUATION IN THE COUPLING CONSTANT FOR THE TOTAL K AND T MATRICES. Garibotti, C. R.; Villani, M. (Univ., Bari, Italy). Nuovo Cim., 59A: 107-23(Jan. 1, 1969).

Potential theory is studied using an approach which gives the total K and T matrices as expansions that are convergent for almost any value of the coupling constant. They are combinations of terms of the Born series, with coefficients which are related to the Padé approximant of the forward K and T matrices. Since these coefficients depend only on the energy, the final expression for the total scattering amplitude has the correct analytic structure. Furthermore, the method provides a way to calculate both bound states and resonances. (auth)

10860 HIGH-ENERGY MODELS PROCEEDING VIA BARYONIC EXCHANGES IN TERMS OF DIRECT-CHANNEL AMPLITUDES. Ader, J. P.; Capdeville, M.; Rimpault, M. (Faculte des Sciences, Bordeaux). Nuovo Cim., 59A: 40-52(Jan. 1, 1969).

The formulation of high-energy exchange models in terms of direct-channel amplitudes is applied to two-body reactions described by fermion Regge poles. It is shown that the analytic properties can be satisfied only with amplitudes determined by a pair of conspiring Regge trajectories. The asymptotic behavior of physical quantities is examined in connection with the oscillating behavior of scattering amplitudes. Besides allowing a generalization of well-known facts obtained from pseudoscalar-meson–nucleon scattering, the results constitute a very convenient parametrization of the helicity amplitudes, useful in the phenomenological analysis of two-body experiments at high energy with fermionic exchanges. (auth)

10861 CONSTRUCTION OF THE SCATTERING AMPLITUDE FROM THE DIFFERENTIAL CROSS-SECTIONS. Martin, A. (CERN, Geneva). Nuovo Cim., 59A: 131-52(Jan. 1, 1969).

A sufficient condition is rigorously established for the existence of a scattering amplitude corresponding to a given angular distribution for scalar particles in the elastic region. The condition is $\max\,[(1/4\pi)\cdot\int|F(13)||F(23)|d\Omega_3/|F(12)|] = \sin\mu < 1$. It is shown that if $|\sin\mu| < 0.79$ the amplitude is unique, except for one obvious ambiguity. Further, by examining the case of a finite, but arbitrarily large number of partial waves it is shown that it is very likely that the solution is still unique for $0.79 < \sin\mu < 1$. The number of solutions in other situations is also discussed. (auth)

10862 ANALYTICITY AND HIGH-ENERGY SCATTERING. Bialas, A. (Jagellonian Univ., Krakow). pp 159-92 of Methods in Subnuclear Physics. Vol. 1. Nikolic, M. (ed.). New York, Gordon and Breach, Science Publishers, Inc., 1968.

The lectures consist of two parts. In the first part some elementary notions and ideas of the scattering theory are explained. The definition of the cross section is first given and, after a short explanation of the adopted normalization, the scattering matrix is introduced and its relation to the cross section is discussed. The constraints on the scattering matrix due to the energy and momentum conservation are described. The unitarity condition is then derived and the optical theorem is presented. This part concludes with a brief description of the kinematics of the two-body reactions. The second part of the lectures deals with the problems of high-energy scattering. Some consequences of the analyticity of the scattering amplitude in the complex energy plane are discussed. (L.B.S.)

10863 MACDOWELL SYMMETRY. Kanki, Takeshi (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 40: 1125-30(Nov. 1968).

In the study of the scattering of a Dirac particle in a central scalar field, the following is emphasized; in order to get the full implications of the MacDowell symmetry, one has to go beyond scattering amplitudes and to see a certain property of partial-wave spinor wave functions. It is shown that the spinor wave functions with incoming boundary condition are not analytic in the lower half k-plane (k is a momentum) but have a kinematical cut running from $-iM$ to $-i\infty$. The second sheet wave functions are obtained by analytic continuation through this cut. This analytic continuation defines the operation which changes the sign of the total energy W and leads to precise scattering amplitudes for negative W. This exemplifies MacDowell symmetry. The reflec-

tion symmetry of fermion Regge trajectories, suggested recently, is also the immediate consequence of this property of wave functions. (auth)

10864 DOUBLE AND MULTIPLE BREIT-SYSTEM HELICITY AMPLITUDES. Koba, Z. (Univ. of Copenhagen). Nucl. Phys., B8: 351-64(1968).

A variant of the helicity formalism is presented, where the helicities of incoming and outgoing particles are referred to a pair (or a set) of properly chosen Breit systems. The reaction amplitudes are then directly related to the crossed channel CMS helicities, thus affording a convenient description of high energy peripheral collisions. This article includes: general definition of the double-Breit-system (DBS) helicity amplitudes (sect. 2), their basic properties (sect. 3), simplified form of crossing relations and its application (sect. 4), description of high-energy peripheral collisions (sect. 5), two examples of the DBS helicity amplitudes (sect. 6), and generalization to the $n \geq 3$ particle final states (sect. 7). (auth)

10865 STRUCTURE OF OVERLAP FUNCTION AND PERIPHERALITY OF PRODUCTION PROCESSES. Koba, Ziro; Namiki, Mikio (Univ. of Copenhagen). Nucl. Phys., B8: 413-30(1968).

Contributions of inelastic channel wave functions in the momentum representation to the elastic diffraction constant are analyzed, using the overlap function method, and are interpreted on the basis of the wave-packet formalism. The elastic diffraction constant is shown to consist of a sum of two positive terms coming from the modulus and the phase of inelastic channel wave functions, respectively. The uncorrelated-jet model and the multi-Regge model are investigated in detail. (auth)

10866 PROPERTIES OF THE POMERANCHUK POLE AND OF THE RELATED BRANCH POINTS AT SMALL MOMENTUM TRANSFERS. Gribov, V. N.; Migdal, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 8: 1002-15(Nov. 1968). (In Russian).

Properties of the Pomeranchuk pole and of the branch points related to it at small momentum transfers, are investigated. It is shown that because of the fact that the reggeon interaction has not Hermitian form a solution exits with a quasistable Pomeranchuk pole, i.e., with the vanishing amplitudes of two- and three-reggeon decay and with the vanishing reggeon scattering amplitude at zero momentum transfer. Explicit form of these amplitudes at small momentum transfers is found. The unitarity condition for the reggeon-particle scattering amplitude in the s channel is obtained. This unitarity condition gives a lower bound for the amplitude of transition of two particles into two reggeons that determines the magnitude of the contribution from the two-reggeon cut. (auth)

10867 TEST OF AN ANSATZ FOR THE RESIDUE OF THE P' REGGE TRAJECTORY. Beretvas, A.; Booth, N. E. (Univ. of Chicago). Phys. Rev. Lett., 22: 113-15(Jan. 20, 1969).

The residue of the P' trajectory has been obtained from experimental data and found to be in agreement with the Ansatz of Barger and Phillips. (auth)

10868 SEMIPHENOMENOLOGICAL ANALYSIS OF SCATTERING AMPLITUDE AT HIGH ENERGIES. Savrin, V. I.; Khrustalev, O. A. (Inst. of High-Energy Physics, Serpukhov, USSR). Yadern. Fiz., 8: 1016-19(Nov. 1968). (In Russian).

An asymptotic formula is obtained which expresses the scattering amplitude through the contribution of inelastic channels of the reaction. (auth)

Particle Accelerators

Refer also to abstracts 9805, 10922, 10936, and 10997.

10869 (BNL-13095) ANALYTICAL DESIGN OF SUPERCONDUCTING MULTIPOLAR MAGNETS. Beth, Richard A. (Brookhaven National Lab., Upton, N. Y.). [1967]. 21p. (CONF-680621-14). Dep. CFSTI.

From Conference on Superconducting Devices and Accelerators, Upton, N. Y.

For accelerator and other applications, transverse magnetic fields are used to guide and focus beams of charged particles. When the beam cross section dimensions are small compared to the radius of curvature of the beam, it is often an appropriate simplification to use a two-dimensional analysis to make the initial design of a magnet. Complex variable methods for analysis of two-dimensional fields are described and illustrated. (W.H.K.)

10870 (BNL-13096) PULSED SUPERCONDUCTING MAGNETS. Sampson, W. B. (Brookhaven National Lab., Upton, N. Y.). [1967]. 7p. (CONF-680621-15). Dep. CFSTI.

From Conference on Superconducting Devices and Accelerators, Upton, N. Y.

Properties of pulsed niobium-tin superconducting magnets for use in large proton synchrotrons are investigated. (W.H.K.)

10871 (BNL-13103) TRANSVERSE SPACE-CHARGE EFFECTS IN BUNCHED BEAMS IN A TRANSPORT SYSTEM. Claus, J. (Brookhaven National Lab., Upton, N. Y.). Aug. 1, 1968. 16p. Dep. CFSTI.

An analytical approach to the problem of space charge effects in the AGS based on the assumption of disregardably small coherent and incoherent energy errors and disregardably small longitudinal space-charge forces is discussed. The bunches are assumed to be sufficiently long compared to their cross sections to calculate the space-charge forces from cylindrical symmetry. Two possibilities are considered: a transport system without any focusing and one with a periodic focusing quadrupole system. (W.H.K.)

10872 (BNL-13122) DATA ACQUISITION AND ANALYSIS COMPLEX FOR THE BNL LOW ENERGY ACCELERATOR FACILITY. Rogers, P. C. (Brookhaven National Lab., Upton, N. Y.). [1969]. 4p. (CONF-681017-15). Dep. CFSTI.

From 15th Nuclear Science Symposium, Montreal, Canada.

The Data Acquisition and Analysis Complex is based on an SDS Sigma-7 computer with special purpose hardware. This complex will be time-shared by users at four independent accelerators. Each user may perform computations or data analysis while simultaneously collecting data and displaying results. A special feature of this complex is that the displays, programs and data are maintained on disc memories thus freeing the central processor and core memory for independent time-sharing tasks. (auth)

10873 (CEA-R-3580) STUDY OF THE MODIFICATION OF THE REGULATION OF THE CADARACHE VAN DE GRAAFF GENERATOR. Le Bot, Michel; Rion, Jacky (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Sept. 1968. 23p. (In French). Dep.

The complete renewal of the energy control equipment of the Van de Graaff generator at Cadarache has been accompanied by a certain number of modifications intended to improve the running and operation of the assembly. The most important work has been the addition of an extra control loop making it possible to keep the voltage on the accelerating tube in the absence of a beam. Analog simulation has made it possible to show the advantages of this solution and the effect of some of its limits. (auth)

10874 (LA-4053) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Status Report for the Period Ending October 31, 1968. (Los Alamos Scientific Lab., N. Mex.). Dec. 10, 1968. Contract W-7405-eng-36. 51p. Dep. CFSTI.

Operation of the Electron Prototype Accelerator is described, and design studies and prototype development for the Los Alamos Meson Physics Facility are outlined. RF power systems, accelerator control and instrumentation, accelerator physics, the experimental area, LAMPF scheduling and facility construction, and physics research are discussed. (W.H.K.)

10875 (UCRL-18424) EVALUATION OF FLUXES AND DOSE-EQUIVALENT RATES IN NEUTRON FIELDS AROUND HIGH ENERGY PROTON ACCELERATORS. Rindi, Alessandro (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1968. Contract W-7405-eng-48. 33p. (CONF-690103-1). Dep. CFSTI.

From Health Physics Society Midyear Topical Symposium, Los Angeles, Calif.

An analysis is made of the errors involved in routine measurements of flux and dose equivalent around high-energy accelerators. By use of some typical neutron spectra from multidetector measurements made around the accelerators at the Lawrence Radiation Laboratory, Berkeley, and the proton synchrotron at CERN, Geneva, a calculation is made of the errors involved when only one detector is used for evaluating the total neutron flux and corresponding dose-equivalent rate. The correction factors to be applied to the routine measurements in these fields have been calculated, and a method is proposed for minimizing those errors. A CDC-6600 computer was used to make the calculations. (auth)

10876 (UCRL-18498) THE ELECTRON-RING ACCELERATOR PROGRAM AT LRL. Allison, R. W. Jr.; Avery, R. T.; Baker, W. R.; (and others) (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1, 1968. Contract W-7405-eng-48.

14p. (CONF-681029-1). Dep. CFSTI.
From National Particle Accelerator Conference, Moscow, USSR.

A progress report is presented on the activities at LRL in connection with electron-ring accelerators. A two-stage compressor unit (employing only low-intensity beams) has been built, and operated with a 4-MeV 100-mA linac as an injector. Electron rings have been formed and compressed from 20 cm radius to 7 cm radius. A three-stage compression unit has been constructed and is now under test with the high intensity (200 A) 3.3-MeV beam of the Astron injector. The apparatus is described. Design work on a magnetic expansion unit is reported. (auth)

10877 HIGH INTENSITY, LOW ENERGY SPREAD ION SOURCE FOR CHEMICAL ACCELERATORS. Menzinger, Michael; Wahlin, Lars (Univ. of Colorado, Boulder). Rev. Sci. Instrum., 40: 102-5(Jan. 1969).

A simple plasma ion source which is capable of delivering beams of 1×10^{-6} A at 200 eV and 0.1–0.2 eV energy spread is described. Gas efficiencies of the order of percents are obtained. This source was found to be very successful in experiments using low energy beams in the electron volt region. (auth)

10878 BEAM CURRENT LOADING OF A TRAVELING-WAVE LINEAR ELECTRON ACCELERATOR. Koroza, V. I.; Shal'nov, A. V.; Volodin, V. A. Zh. Tekh. Fiz., 38: 1126-30(July 1968). (In Russian).

A theoretical treatment of the beam current loading effect, limited to the case of uniform bunch motion on the symmetric E-wave in a homogeneous slow-wave system is discussed. It is assumed that electron bunches can be located at any phase of the field wave, and the field itself is considered to be the resultant of the Cherenkov radiation field, generated by the bunches of accelerated particles, being superimposed on the field created by the rf-generator. This approach leads to some new results which differ from those obtained by G. Saxon (Proc. Phys. Soc. 67B, 705, 1954) on the basis of the power balance equation. It is shown that when the bunches are injected elsewhere than at the wave top of the accelerating field, the current loading leads to a change in the phase velocity of the resultant accelerating wave, and the formula is given for this change. In this connection, the expression is derived for the maximum length of the accelerating section. Its calculated value is smaller than the one obtained from the Saxon formula. This additional limitation on the length of the accelerating section also reduces the possible energy gain in the section. (ATD)

10879 DIFFERENTIALLY PUMPED, LARGE ANGLE COINCIDENCE SCATTERING CHAMBER FOR ATOMIC COLLISIONS. Kessel, Quentin C. (High Voltage Engineering Corp., Burlington, Mass.). Rev. Sci. Instrum., 40: 68-70(Jan. 1969).

A differentially pumped, atomic scattering chamber capable of detecting both ions following a large angle collision is described. This chamber is designed for use with incident ions having energies from 0.5 to 10 MeV. A construction technique is used which eliminates bellows and allows detection of atoms and ions over an angular range of 185°. (auth)

10880 SIMPLE DESIGN FOR AN ION SOURCE OF THE OSCILLATING ELECTRON BEAM TYPE. Crowder, Billy L.; Penebre, N. A. (IBM Watson Research Center, Yorktown Heights, N. Y.). Rev. Sci. Instrum., 40: 170-1(Jan. 1969).

The design of an oscillating electron ion source for ion implantation doping of semiconductors is briefly described. (W.H.K.)

10881 COAXION: A NEW ION SOURCE. Roach, T. (CBS Labs., Stamford, Conn.). Rev. Sci. Instrum., 40: 179-80(Jan. 1969).

The design and construction of Coaxion, which employs a coaxial contact ionizer and vapor source, are described. Performance characteristics of this ion source for cesium ion implantation are discussed. (W.H.K.)

10882 INVESTIGATION OF THE NONSTATIONARY CURRENT IN A BETATRON WITHOUT AN IRON CORE. Zhukov, O. E.; Ivanov, D. P.; Korobochko, Yu. S. (Leningrad Polytechnic Inst.). Zh. Tekh. Fiz., 38: 1067-9(June 1968). (In Russian).

Several parameters that characterize the dynamics of the electrons in a core-less betatron (with an increasing axial parameter) were investigated experimentally. The experiments were conducted on a model betatron with electron acceleration up to 100 keV. Injection with a Kerst-type gun provided a trapezoidal waveform of the beam with rise time of less than 10^{-6} sec and angular dispersion of 6 degrees. The study of the injected charge showed that during injection, the space charge fills the entire volume of the chamber and is nearly uniformly distributed in the operating chamber. The nonstationary current was found to depend linearly on the length of the accelerating chamber. To complete the investigation, this current (which circulates in the betatron) was also determined to depend on the injection current, rate of bremsstrahlung radiation and the mean number of cycles in the betatron during the injection period. These dependences are plotted. The authors thank A. P. Komar for his interest in the work. (ATD)

10883 MAINTENANCE OF BEAM STABILITY IN MEDICAL LINEAR ACCELERATOR. Okumura, Yutaka; Ueda, Toshio (Aichi Cancer Center Research Inst., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 990-3(Oct. 1968). (In Japanese).

In radiation therapy it is necessary to give required dose of radiations over planned area. For this purpose, the following items should be maintained: (1) coincidence of optical and x-rays fields, (2) symmetry of radiation flux intensity, (3) stability of monitor ionization chamber and (4) stability of x-rays energy. From measurements of these factors through long time, it is concluded that coincidence of fields, stability of monitor chamber and stability of energy should be measured and confirmed the stability once a month and symmetry of flux intensity every day before radiation therapy. Since it is not practically easy to measure flux intensity every day, it is desirable to make a special chamber for monitoring it and a balancing circuit automatically obtaining its symmetry. (auth) (NSA of Japan)

10884 NONRELATIVISTIC NUCLEAR REACTION KINEMATIC CROSSOVER ANGLES. Warshaw, Stephen I. (Univ. of Illinois, Urbana). Rev. Sci. Instrum., 40: 37-9(Jan. 1969).

A nonrelativistic expression relating the bombarding energy to the laboratory angle at which the energies of reaction products from two dissimilar nuclear reactions coincide is derived and discussed. Applications to accelerator beam energy measurement, detector angular calibration, and nuclear reaction experiment planning are considered. (auth)

10885 METHOD AND DEVICE FOR PROTECTING AGAINST ACCIDENTAL BEAM DEVIATION IN LINEAR PARTICLE ACCELERATORS. Guilbaud, Georges; Soffer, Jacques (to Commissariat a l'Energie Atomique). British Patent 1,137,776. Dec. 27, 1968. Priority date Sept. 24, 1965, France.

In order to prevent extensive damage to sections of a linear accelerator due to abnormal beam deviations, a device for reducing the power of the beam by reducing the repetition rate of the high-frequency pluses is described. (B.G.D.)

10886 ACCELERATORS FOR HIGH INTENSITIES AND HIGH ENERGIES. Courant, Ernest D. (Brookhaven National Lab., Upton, N. Y. State Univ. of New York, Stony Brook). Annu. Rev. Nucl. Sci., 18: 435-64(1968).

Some of the principles underlying the intensity limitations and design considerations for high-intensity and high-energy accelerators and colliding-beam rings are discussed. Some new and projected accelerators designed either for high intensity near 1 GeV or for very high energy are described. (B.G.D.)

10887 HEAVY ION ACCELERATORS. Wittkower, A. B.; Robinson, D. M.; Rose, P. H. (High Voltage Engineering Corp., Burlington, Mass.). Sci. J., 5: 53-9(Jan. 1969).

A brief description is given of the all-purpose circular heavy ion accelerator known as the Omnitron, developed at the Lawrence Radiation Laboratory of the University of California. Also described are two versions of heavy ion accelerators based on the dg tandem Van de Graaff–viz the Hilab accelerator now under construction at Burlington, and the Hortig accelerator, at present at the feasibility stage. Improvements to heavy ion linear accelerators are also mentioned, leading to the Unilac, which is in the pre-construction stage at the Max Planck Institute, Heidelberg. Applications to producing elements beyond element 105 are discussed. (UK)

10888 NEUTRON FLUX DISTRIBUTION AROUND THE TARGET OF A 14 MeV NEUTRON GENERATOR. Oldham, G.; Bibby, D. M. (Loughborough Univ., Eng.). Nucl. Energy, 167-9(Nov.-Dec. 1968).

A neutron generator having a flux at the target of 10^9 n/cm^2/sec is described. The care necessary in the selection of operating conditions to maintain good uniformity of neutron emission is stressed. The flux distribution measurements were made by means of Cu discs, employing the ^{65}Cu(n,2n) reaction; the activity was measured by a NaI scintillation counter. Graphs show the log of the normalized flux against the distance from the generator axis for the position closest to the target, and up to 4 cm above and below. (UK)

10889 PHOTONEUTRON PRODUCTION IN THICK BREMSSTRAHLUNG TARGETS. Dealler, J. F. B. (Univ. of Birmingham, Eng.). Health Phys., 16: 238-9(Feb. 1969).

When calculating the shielding required for an electron ac-

celerator operating at energies exceeding the threshold for the production of photoneutrons it is necessary to take into account the photoneutron flux produced by bremsstrahlung, and in order to test whether additional shielding is required for these neutrons it is convenient to calculate the neutrons produced by thick target bremsstrahlung in a heavy metal beam stopper of such shape that neutrons traveling perpendicular to the beam suffer relatively small attenuation. The NBS Handbook 97 (1964) gives an approximate formula stated to be sufficiently accurate for shielding purposes for energies >5 MeV above the giant resonance for photoneutron production, but this may not be entirely reliable since it depends on a thin target bremsstrahlung approximation. Photoneutron production from a variety of target materials has been measured as a function of electron energy and absorber thickness, and since these thicknesses greatly exceeded the optimum thickness for bremsstrahlung production at energies in the region of the giant resonance it is reasonable to extrapolate to infinite target thickness by application of the absorption coefficient appropriate to the bremsstrahlung energy. Results for thick target photoneutron production from electron beams of 10 to 30 MeV are shown plotted (a) for a heavy metal target as calculated from the NBS Handbook, (b) for an infinite target, and (c) for a target of thickness equal to the primary electron range. The graph provides data for energies <23 MeV and demonstrates the effect of substituting thick target bremsstrahlung for thin target. (UK)

10890 RECTIFIER FOR ACCELERATOR MAGNETS. Cassel, R. L. (to United States Atomic Energy Commission). U. S. Patent 3,421,071. Jan. 7, 1969.

A power supply for high energy, charged particle, accelerator magnets is described. Alternating current from a generator having y-connected windings is rectified and supplied to the magnets at increasing or constant voltages with low ripple and low power requirements by sequentially firing separate groups of rectifiers to share the current of the y-connected generator windings. (AEC)

10891 MULTIPOLE MAGNET HAVING A SEQUENTIALLY SHIM STEPPED COIL CONFIGURATION. Sampson, W. B.; Britton, R. B.; Kruger, P. G.; Beth, R. A. (to United States Atomic Energy Commission). U. S. Patent 3,423,706. Jan. 21, 1969.

Apparatus for forming a magnetic field with 2n poles within a longitudinally extending aperture having longitudinally extending side-by-side, annular, conductive coils external to and forming said aperture are described. In one embodiment, the coils are formed from superconducting ribbons that are shim-stepped around the aperture to approximate a smoothly varying current sheet function and provide a quadrupole magnetic field for focusing charged particles. (AEC)

10892 LAMINATION TRANSFORMER TYPE ACCELERATOR. Masuda, Masami. Japanese Patent 1968-20233. Aug. 30, 1968. Filed July 8, 1963.

The accelerator proposed by means of electromagnetic-induction voltage has the advantages of elimination of insufficient electron-ray output, insufficient output voltage, and large size. For generation of the alternating current, it includes a laminated central core with coils; an accelerating tube, inserted into the central hole of the core, with the layers separated by insulating plates; a yoke core; other coils; a corona ring, surrounding them; and an iron core, fixed onto the insulating plates. For generation of the direct current, it includes a rectifier element, a condenser and a resistor, on the insulating plates. (NSA of Japan)

10893 BETATRON. Tawara, Hiroyuki (to Hitachi Ltd.). Japanese Patent 1968-22793. Sept. 25, 1968. Filed Jan. 5, 1965.

A method is proposed concerning the medical application of a betatron which has the following advantages: the possibility of giving twice as large a dose to the lesion in a given time, and at the same time, the dosage at parts other than the lesion is half the usual value. In the betatron proposed, there are installed a plurality of electron guns and a corresponding number of targets on the accelerating circular tube. The currents of x-rays (or electrons) from these targets are converged to a point, that is, to the lesion by a suitable means. (NSA of Japan)

10894 PARTICLE ACCELERATOR. Suganomata, Sinji (to Hitachi Ltd.). Japanese Patent 1968-22792. Sept. 25, 1968. Filed Mar. 1, 1965.

A method is proposed whereby targets at the end of the accelerating tube can be exchanged one after another without breaking the vacuum. It consists of the following: an accelerating tube; a flange, fixed at the accelerating-tube end which has a hole running through the flange plate at some distance from the plate center, the hole fitting to the end of the accelerating tube; and a rotating plate, installed onto the flange plate with a packing between, which has the target positions on the inside surface circumferentially. By rotating the target plate, each target on it can be brought to the position of irradiation. (NSA of Japan)

10895 CHARGED-PARTICLE ACCELERATING DEVICE. Suganomata, Sinji (to Hitachi Ltd.). Japanese Patent 1968-22791. Sept. 25, 1968. Filed Jan. 29, 1965.

By the method proposed, the time interval between pulses can be lengthened in comparison with the ordinary devices. The control for accelerated charged-particles consists of the following: a device, placed in the particle path between the accelerating tube and the target, for detecting charged particles; a device, which gives a control signal when the value of detection has reached a preset one; and a gate which obstructs or passes the charged particles to the target, depending on the presence or absence of a control signal. (NSA of Japan)

10896 METHOD AND DEVICE FOR MONITORING THE ENERGIES OF AN IRRADIATION ELECTRON CURRENT. Okabe, Shigeru (to Osaka Prefecture). Japanese Patent 1968-20234. Aug. 30, 1968. Filed Apr. 11, 1963.

The monitoring device proposed can be used, regardless of the type of electron accelerator, without the obstruction of an electron current in a simple and exact manner. The elastic-scattering electrons, produced when an irradiation electron current passes through a foil either at the output window or in the path of the current, are taken out into a branching tube having an electromagnet. By this means, the energy distribution of the electrons is measured, without interrupting the irradiation electron current. This energy distribution is analogous to the distribution of the irradiation electron current. A branching tube, which connects to an energy-analyzing electromagnet, is attached to the irradiation electron current tube. The current passing through the electromagnet, is detected at the outlet of the branching tube. This current and the current of the analyzing electromagnet are sent to the X and Y axes of a Braun tube. (NSA of Japan)

10897 ION–ELECTRON CHANGE-OVER TYPE ELECTROSTATIC PARTICLE ACCELERATOR. 4. DETERMINATION OF ION BEAM ENERGY. Kobayakawa, Mikio; Niwa, Hiroaki (Government Industry Research Inst., Nagoya, Japan). Nagoya Kogyo Gijutsu Shikensho Hokoku, 17: No. 8, 189-96(Aug. 1968). (In Japanese).

Beam energy calibration of a Van de Graaff type accelerator was carried out with resonance energy of 1375 keV in a nuclear reaction $^{19}F(p,\alpha\gamma)^{16}O$. Excitation curves of the nuclear reaction and resonance energies were obtained. The generating voltmeter of the accelerator was calibrated with the obtained resonance energies. The beam energy spread was estimated by an excitation curve of a nuclear reaction $^{27}Al(p,\gamma)^{28}Si$. The following results were obtained. The resonance energies obtained agreed with the values obtained by Hunt within experimental errors. Within the accelerating voltage range of 1.2 to 2.0 MV, the relation between the accelerating voltage V (MV) and the generating voltmeter current I (μA) was expressed by $V = (24.1\ I + 5.2) \times 10^{-2}$. The beam energy spread was about 0.22% and it was consistent with the theoretical consideration of the beam energy analyzer. (NSA of Japan)

10898 PLANS FOR EXPERIMENTAL AREAS AT THE NATIONAL ACCELERATOR LABORATORY. Goldwasser, E. L. (National Accelerator Lab., Oakbrook, Ill.). pp 445-50 of 14th International Conference on High-Energy Physics, Vienna, 28 August–5 September 1968. Prentki, J.; Steinberger, J. (eds.). Geneva, European Organization for Nuclear Research, 1968.
See CONF-680809.

Some features of a model of one possible layout of experimental areas and facilities presented in the initial Design Report of the National Accelerator Laboratory are described. Some definite plans which emerged from the Aspen study program and from work of the previous year are briefly discussed. These include superconductivity research, bubble chamber facilities, hybrid equipment arrays and the streamer chamber, neutrino experiments, and a revised design of a target station and general layout of experimental areas. (L.B.S.)

10899 CURRENT MEASUREMENTS FOR CONTACTLESS DETERMINATION OF THE INTENSITY OF CHARGED PARTICLE BEAMS. Kovalskii, G. A.; Arefev, V. I.; Maishev, Yu. P. Prib. Tekh. Eksp., No. 5, 47-50(Sept.-Oct. 1968). (In Russian).

Two types of apparatuses for contactless measurement of the intensity of charged particles were developed. Tests with these apparatuses showed that it was possible to record currents from several mAmp and above. The design data are presented. (tr-auth)

10900 COMPENSATING SYSTEM FOR INTRODUCTION OF PARTICLES IN THE CONSTANT FIELD OF STORAGE RINGS. Mironov, E. S.; Pakin, V. N.; Silvestrov, G. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Prib. Tekh. Eksp., No. 5, 23-6 (Sept.-Oct. 1968). (In Russian).

A system for introduction of particles in the constant axial-symmetric magnetic field by means of compensation of stray fields by pulsed magnetic fields was described. The magnetic field has a special coaxial profile with currents up to 200 kiloamps, which is fed through small-induction current transformers of toroidal design. (tr-auth)

10901 TELEMETERING SYSTEM FOR THE MEASUREMENT OF PARAMETERS FOR PROTON PREINJECTOR. Bychkov, Yu. A.; Romanov, Yu. I.; Saifulin, Sh. Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 5, 27-31(Sept.-Oct. 1968). (In Russian).

A telemetering system TC-6 for checking parameters of equipment located on a high-voltage column of a 700-keV proton preinjector is described. The TC-6 system uses radiofrequency connections in the 3 cm band and PAM–PTM coding with subsequent transposition into numerical decade coding and time division of channels. For the transfer of information by video channels, frequency modulation of signals from rf channels is used. Five measuring channels are displayed on numerical indicators and one video channel on the screen of an oscilloscope. The TC-6 system is composed mainly of transistors. (tr-auth)

10902 RECORDING OF ELECTRON ORBITS IN MICROTRONS WITH ALKALI-HALIDE COMPOUNDS. Zhuk, A. P.; Kats, M. L.; Nikolskii, V. K.; Sorokin, N. N.; Stepanchuk, V. P. (Saratov State Univ., USSR). Prib. Tekh. Eksp., No. 5, 31-3(Sept.-Oct. 1968). (In Russian).

The use of the coloring action of fast electrons on alkali-halide compounds prepared from salts NaCl, KCl, etc., for obtaining a representation of the beam cross section in microtrons is discussed. The principal applicability of the method and the technology involved are examined. The simplicity by which a true representation can be obtained is shown. (tr-auth)

10903 MAGNETIC SEPARATOR FOR THE ION SOURCE OF AN ELECTROSTATIC ACCELERATOR. Kirillov, A. I.; Morozov, V. M. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 5, 34-5(Sept.-Oct. 1968). (In Russian).

The advantages of separating the ions before injection in the acceleration tube of an electrostatic accelerator are discussed. A magnetic quadrupole separator for separating the ions with a given relation of charge-to-mass on yield is described. An increase in the current of the accelerated ions to more than twice with simultaneous reduction of the electron component in the accelerating tube was achieved by relieving the accelerator from accelerating non-used beam components. (tr-auth)

10904 SYSTEM FOR CHARGING THE TRANSPORTER OF AN ELECTROSTATIC ACCELERATOR. Morozov, V. M.; Morozov, N. A.; Peshkov, A. V. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 5, 36-7(Sept.-Oct. 1968). (In Russian).

A system for charging the transporter of an electrostatic accelerator, including an apparatus for regulating charge on the surface of the transporter and an apparatus for automatically regulating the overcharging of the transporter inside the high-voltage conductor of the accelerator. (tr-auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 9511, 9802, 9811, 10697, 10888, and 11293.

10905 (AECL-3166) PHYSICS DIVISION PROGRESS REPORT, JULY 1-SEPTEMBER 30, 1968. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). 99p. (PR-P-79). Dep. CFSTI. CAN $2.00.

Research and development in nuclear physics, general physics, neutron physics, theoretical physics, and mathematics and computers are outlined. (W.H.K.)

10906 (AERE-R-5867) STUDIES OF THE LIQUID STATE USING THE INELASTIC SCATTERING OF SLOW NEUTRONS. Cocking, Stanley John (Atomic Energy Research Establishment, Harwell (England)). Aug. 1968. 137p. Dep. CFSTI. UK 19s.

Thesis. Submitted to Univ. of London, Eng.

The atomic motions of monatomic liquids, mainly liquid sodium and liquid lead, were studied by observing the spectra of initially monokinetic neutrons after scattering by thin specimens of the liquids. The incident neutrons, with wavelength of 4 Å (or longer), were selected from a reactor beam using a mechanical chopper; and the scattered spectra were analyzed at six different scatter angles by the time-of-flight method. Both incoherent and coherent scattering, which provide information on single-particle and collective motions, respectively, were studied. The basic formalism relating atomic motions to the observed spectra is outlined and developed separately for these two aspects of the motions. 98 references. (auth) (UK)

10907 (AERE-R-5896) AN EVALUATION OF TIME OF FLIGHT AND CONVENTIONAL DIFFRACTION TECHNIQUES AT HARWELL. Day, D. H.; Sinclair, R. N. (Atomic Energy Research Establishment, Harwell (England)). Sept. 1968. 12p. Dep. CFSTI. UK 2s. 6d.

Time-of-flight and conventional continuous source techniques for thermal neutron scattering studies are compared. Experience in three fields of research (structure factor measurement, neutron inelastic scattering and the coherent scattering by liquids) gained in experiments on the pulsed source provided by the Harwell electron linac is used to compare the potentialities of the pulsed source method, with the techniques used at present on the DIDO reactor. The derived figures of merit indicate the power of the time-of-flight method and indicate that the Harwell electron linac can be developed into a pulsed thermal neutron source of comparable standing to the DIDO reactor as at present used, and that the application of pulsed source techniques to the DIDO reactor would give a further factor 20 improvement. (auth) (UK)

10908 (CEA-R-3489) EXPERIMENTAL STUDY OF THE SLOWING DOWN OF FAST NEUTRONS IN THIN PLATES OF HYDROGENATED MATTER. Bayer, Rodolphe (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). June 1968. 32p. (In French). Dep.

The slowing down time of fast neutrons in slabs of hydrogenated matter with finite sizes was measured by two methods: a direct measurement of the delay between the time the fast neutrons enter the moderator and the time the slow neutrons leave it; and an indirect measurement in which a narrow resonance is studied with moderated neutrons whose time distribution is deduced from the apparent width of the resonance. This latter method uses neutrons produced by a linear accelerator and a moderator with a low hydrogen content in order to increase the widening of the resonance. The experimental results were compared with a Monte Carlo calculation on a moderator with infinite lateral sizes. The agreement is satisfactory. (auth)

10909 (EIR-137) NEUTRON THERMALIZATION IN HEAVY WATER; AN INVESTIGATION. Wydler, P. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Aug. 1968. 82p. Dep.

To check different scattering models for heavy water, time-dependent and steady-state spectrum measurements were made. The time-dependent spectra were measured in the pure moderator using a pulsed source and a chopper. The steady-state spectra were observed in cadmium solutions at various distances from a source of fast neutrons provided by a reactor. The neutrons were analyzed by time of flight. Calculations based on diffusion and transport theory were made using the free gas model, the Nelkin-Honeck model, and the Haywood scattering kernel for D_2O. The kernels were found to predict quite different thermalization properties. Theoretical spectra based on the Haywood kernel agreed best with the experimental results. (auth)

10910 (JINR-P3-4127) OBSERVATION OF THE ULTRA COLD NEUTRONS. Lushchikov, V. I.; Pokotilovskii, Yu. N.; Strelkov, A. V.; Shapiro, F. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1968. 17p. (In Russian). Dep.

An experiment on observation of the ultracold neutrons performed on the pulsed fast reactor is described. The storage time of neutrons in copper tubes is equal to 200 sec. (auth)

10911 (KAPL-M-6923) CLEM: A LEGENDRE POLYNOMIAL FITTING PROGRAM WITH A NON-NEGATIVITY CONSTRAINT. Slavik, C. J.; Lubitz, C. R.; Reynolds, J. T. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 22, 1968. Contract W-31-109-eng-52. 17p. Dep. CFSTI.

A program which generates constrained Legendre moments for neutron scattering angular distributions is described. The constraint referred to is that the angular distribution itself should be non-negative. This minimizes the problem of negative angular distributions which some design programs are unable to handle. (auth)

10912 (ORNL-tr-2046) STUDY OF THE DECAY OF PHOTONEUTRONS IN BERYLLIUM AFTER A FISSION OF ^{235}U. Winter, Heinz; Deledicq, Helene (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report CEA-Note-N-971. 18p. Dep. CFSTI.

The available data on photoneutron production in Be by ^{235}U fission-product γ rays were compiled, and photoneutron decay in Be was calculated directly from the spectrum of the fission-product γ rays of ^{235}U. The calculations were compared with the experimental data. (D.C.W.)

10913 (SRARI-P-8) THE CALCULATION OF TRANSPORT OPERATOR SPECTRUM IN THE SPHERICAL GEOMETRY FOR MONOENERGETIC NEUTRONS WITH SCATTERING ANISOTROPY BEING TAKEN INTO ACCOUNT AND FOR NELKIN THERMALIZATION MODEL. Shkurpelov, A. A.; Shikhov, S. B. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1968. 32p. (In Russian). Dep.

Some problems of neutron transport theory are considered. A method is suggested by means of which the operator spectrum for monoenergetic neutron transport in spherical geometry may be calculated considering scattering anisotropy. Account is taken of the energetic energy-cross section relation by the Nelkin thermalization pattern. The appropriate analytical formulas for the calculation of the eigenvalues are obtained. Eigenvalue-sphere radius relations are shown. (auth)

10914 (WANL-TME-1854) TWO PHONON INELASTIC COHERENT THERMAL SCATTERING CROSS SECTION OF BERYLLIUM. Johnston, A. S. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Sept. 1968. Subcontract NP-1. 239p. Dep. CFSTI.

A calculation of the two-phonon coherent neutron scattering cross section for single-crystal Be in the harmonic approximation was done. The calculation was performed by approximating the sums over eigenmodes by sums in which the terms are evaluated at mesh points in the first Brillouin zone. The Born-von Karman model of deWames, Wolfram, and Lehman for Be was used. Results were obtained as a histogram giving the scattering law for fixed neutron wave vector change versus the neutron energy transfer. Preliminary calculations yield the coherent two-phonon neutron cross section a factor of 10 to 100 less than the value given by the incoherent approximation. The scattering law and total inelastic scattering cross section in the multiphonon incoherent approximation were calculated using a frequency distribution derived from the deWames, Wolfram, Lehman dynamical model of Be. The results give the total inelastic cross section as less than that obtained by Young and Koppel. The difference is greatest at low temperature (77.4°K). (auth)

10915 (WCAP-3688-1) ETOM-1: A FORTRAN IV PROGRAM TO PROCESS DATA FROM THE ENDF/B FILE TO THE MUFT FORMAT. Dannels, Robert A.; Kusner, Daniel E. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). May 1968. Contract AT(30-1)-3688. 86p. (ENDF-113). Dep. CFSTI.

ETOM-1 is a digital computer program which processes basic nuclear data in the ENDF/B format and produces library data for

the MUFT or P1MG programs. ETOM-1 is written entirely in ASA standard FORTRAN and is designed to be computer independent. Along with printed results, the output includes punched cards in the format appropriate to the desired library. (auth)

10916 CONTINUED FRACTION REPRESENTATION FOR SLOW NEUTRON SCATTERING. Sears, V. F. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Can. J. Phys., 47: 199-208 (Jan. 15, 1969).

Mori's continued fraction representation for calculating autocorrelation functions of dynamical variables is applied to the problem of slow neutron scattering by simple classical liquids. In particular, the first few "long-time" approximations are evaluated for the velocity autocorrelation function and for the incoherent and coherent scattering functions. In this way, many of the standard results of slow neutron scattering theory are obtained without having to make any of the ad hoc assumptions which usually enter the derivation of these results. In addition, the continued fraction representation provides a natural method of extending these results to higher order. Numerical calculations are made for liquid argon and are compared with available experimental data and with Rahman's machine computations. (auth) (Canada)

10917 MEASUREMENT AND CALCULATION OF FIXED NEUTRON SPECTRA USING RESONANCE ABSORBERS TO POISON THE MODERATOR. Wuerz, H. (Kernforschungszentrums, Karlsruhe, Ger.). Nukleonik, 11: 270-6(Oct. 1968). (In German).

The time-of-flight method was used in the energy range under 10 eV for the measurement of the energy-dependent neutron distribution. Water and aqueous solutions of cadmium, samarium, indium, and erbium salts in various concentrations were used as moderator and absorber. Spectra were obtained from the surface of all and from the middle of two of the moderators. From the energy dependence of the transport path length and the space dependence of the flux, the neutron distributions on the boundary and in the middle of a medium deviate sharply from each other. By numerical solution of the space- and energy-dependent neutron transport equation, neutron spectra were calculated. The results of calculations and measurements were compared. (tr-auth)

10918 INELASTIC SCATTERING OF NEUTRONS BY POLYCRYSTALS. de Wette, F. W. (Univ. of Texas, Austin); Rahman, Aneesur. Phys. Rev., 176: 784-90(Dec. 15, 1968).

A first-principle calculation of the one-phonon, coherent, polycrystalline, inelastic scattering cross section for neutrons has been carried out for a monatomic fcc crystal; the quasiharmonic force constants were obtained from a Lennard-Jones (6-12) potential of interaction between the particles. The calculations were made for three values of the crystal density. The prescription of Egelstaff for calculating this cross section is found to be inadequate, and the formula of Marshall and Stuart is shown to be identical with that of Egelstaff. (auth)

10919 WIDTHS OF PEAKS IN ONE-PHONON SCATTERING OF NEUTRONS BY MOLECULAR CRYSTALS. Zhidkov, L. G.; Korshunov, A. V.; Tretyakov, A. G. Izv. Vyssh. Ucheb. Zaved., Fiz., No. 9, 31-4(1968). (In Russian).

The width and the displacement of the peak in coherent one-phonon scattering of neutrons by an anharmonic molecular crystal were calculated assuming rigid molecules. (tr-auth)

10920 PHENOMENOLOGY OF NEUTRON SCATTERING IN HEISENBERG SYSTEMS. Bennett, Herbert S. (National Bureau of Standards, Washington, D. C.). Phys. Rev., 176: 650-4(Dec. 10, 1968).

The magnetic scattering of neutrons from Heisenberg systems is discussed within the rigorous framework of spectral representations for the longitudinal and transverse spectral weight functions, low-order moments of these functions, and their sum rules. The spectral weight functions are expressed as functionals of longitudinal and transverse diffusivities. This exact framework leads naturally to a two-parameter phenomenological description of the neutron-scattering cross section in Heisenberg ferromagnets. It is shown that replacing the diffusivities by two-parameter Gaussian functions, which satisfy the first two sum rules, gives the essential features for the neutron-scattering cross section in ferromagnets. (auth)

10921 PHONON SPECTRUM AND THERMAL NEUTRON SCATTERING IN LIGHT WATER ICE. Nakahara, Yasuaki (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo), 5: 635-42(Dec. 1968).

The phonon spectrum of light water ice at 0°C was calculated by the root sampling method for a sampling of 1,050 points in an irreducible sampling region of the first Brillouin zone. The scattering law for thermal neutron scattering in hexagonal ice was also calculated and was found to agree well with reported experimental values. (auth)

10922 PRODUCTION OF HIGH FREQUENCY NEUTRON WAVES FROM A POSITIVE-ION ELECTROSTATIC ACCELERATOR. Foley, John E.; Seale, Robert L. (Univ. of Arizona, Tucson). Nucl. Appl., 6: 142-6(Feb. 1969).

A modulated neutron source was constructed by alternately spreading and converging the ion beam from a 2-MeV Van de Graaff accelerator striking a neutron-producing target. This spreading and converging is accomplished by applying a time-varying voltage to the electrodes of an electrostatic quadrupole lens located in the beam tube of the accelerator a few meters from the target. The system is capable of producing neutron waves of frequencies between a few Hz to over 100,000 Hz with little harmonic distortion. No modification of the accelerator is required, and all necessary equipment is commercially available. (auth)

10923 NOI APPROXIMATII IN TEORIA TRANSPORTULUI NEUTRONILOR. (New Approximations in Neutron Transport Theory). Rosescu, Teodor. Bucuresti, Editura Academiei Republicii Socialiste Romania, 1968. 325p. Lei 21,50.

Approximate methods for the solution of the neutron transport equation are outlined including polynomial approximations, integral approximations, the invariant imbedding approximation, the variational calculus and perturbation theory, the thermodynamic approximation, the quantum-mechanical approximation, the abstract approach, stochastic approximations, and numerical approximations. (D.C.W.)

10924 COHERENT SCATTERING AMPLITUDES MEASURED BY SMALL-ANGLE SCATTERING OF NEUTRONS. Koester, L.; Ungerer, H. (Technische Hochschule, Munich). Z. Phys., 219: 300-10(1969). (In German).

Using the small-angle scattering of neutrons by a Christiansen filter (a mixture of a grained powder with a liquid), it was possible to determine the scattering amplitude of powders and liquids with an error within ±1% or lower. By measurements with tungsten powder and mixtures of the liquids C_2Cl_4 and C_6H_5Cl and with mixtures of heavy and light water, the scattering amplitudes of the bound atoms were obtained. (auth)

10925 SOLUTIONS TO THE NEUTRON TRANSPORT FOR A CRITICAL SLAB BY PERTURBATION THEORY. Hendry, W. L. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36). J. Math. Phys. (N. Y.), 8: 1619-30(Aug. 1967). (LA-DC-8159).

A perturbation-theoretic method is developed by which solutions to the monoenergetic neutron transport equation for an unreflected critical slab can be obtained in the case of anisotropic scattering and/or nonconstant cross sections. The method rests upon the use of a generalized Green's function to solve the perturbation equations. The Green's function is derived by an eigenfunction expansion technique and as the solution to two coupled singular integral equations, and the results are compared numerically. (auth)

10926 METHOD OF DETERMINING NEUTRON SPECTRA FROM REACTION RATES AND A HYPOTHETICAL SPECTRUM. Ebersoldt, F. (EURATOM, St. Paul-les-Durance, France). J. Nucl. Energy, 22: 665-73(Nov. 1968).

Neutron spectra can be determined from reaction rates when a crude approximation of the unknown spectrum is available. The assumed spectrum is corrected by addition of a correction function calculated from the measured reaction rates. A smoothing parameter allows elimination of undesired oscillations in the solution which are due to statistical errors affecting the reaction rates. These errors are evaluated. (auth) (UK)

10927 NEUTRON SCATTERING FROM PARAMAGNETS. Kwon, T. H.; Gersch, H. A. (Georgia Inst. of Tech., Atlanta). J. Phys., C (London), 1: 1563-7(Dec. 1968).

The frequency transform of the time-dependent two-spin autocorrelation function is evaluated using the modified paramagnetic neutron scattering function introduced by Collins and Marshall (1967). The dimensional effects on one-, two-, and three-dimensional crystals are demonstrated, and the physical basis for such dimensional effects is discussed. For the one-dimensional Heisenberg paramagnet comparison with exact calculations by Carboni and Richards (1968) shows a marked improvement over the Gaussian distribution commonly assumed in the description of paramagnetic neutron scattering. (auth) (UK)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 10905, 10939, and 11077.

10928 (UCLA-10-P-18-10) RESEARCH PROGRAM OF THE NUCLEAR CONSORTIUM AT THE UCLA CYCLOTRON LABORATORY. Richardson, J. Reginald; Wright, Byron T. (California Univ., Los Angeles. Dept. of Physics); Louisell, William H. (University of Southern California, Los Angeles. Dept. of Physics); Eisberg, Robert M. (California Univ., Santa Barbara. Dept. of Physics). July 1968. Contract AT(11-1)-Gen-10. 122p. Dep. CFSTI.

Experimental studies were made of the proton-induced breakup of D, ^{3}He, and ^{4}He; proton elastic scattering by D and ^{4}He; proton-induced reactions on ^{14}N; proton elastic and inelastic scattering by ^{16}O; the reactions ^{19}F(p,t)^{17}F and ^{19}F(p,^{3}He)^{17}O; the reaction ^{20}Ne(p,pα)^{16}O; the reaction ^{89}Y(p,2p)^{88}Sr; proton-induced reactions on ^{209}Bi; nuclear bremsstrahlung in proton bombardment of ^{12}C; first forbidden β decay of ^{139}Ba; energy losses by fast charged particles in Si; nuclear reaction efficiency corrections for Ge and Si detectors; and the problem of nuclear reactions in high-energy stopping counters. Proton total cross sections for ^{9}Be, ^{12}C, ^{16}O, and Si were measured between 24 and 46 MeV. Analyses of the proton-induced breakup of D and ^{4}He and of the reaction ^{12}C(p,2p)^{11}B were performed, as was an optical model analysis of proton elastic scattering by ^{16}O at 23 to 53 MeV. Log-ft values were calculated for allowed, pure Gamow-Teller transitions in even-A single closed shell nuclei with Z = 28, Z = 50, and N = 82. (D.C.W.)

10929 (UCRL-70522) MAXWELL AVERAGED CROSS SECTIONS FOR SOME THERMONUCLEAR REACTIONS ON LIGHT ISOTOPES. Greene, Samuel L. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). May 1967. Contract W-7405-eng-48. 48p. Dep. CFSTI.

The literature was searched through December 1964 for total cross section data on the ten reactions D(d,p)T, D(d,n)^{3}He, T + T total, T + ^{3}He total, T(d,n)^{4}He, ^{3}He(d,p)^{4}He, ^{6}Li(d,n)^{7}Be, ^{6}Li(d,p)^{7}Li, ^{6}Li(d,t)^{5}Li, ^{6}Li(d,α)^{4}He. Weighted least square fits of the experimental total cross section for each reaction were obtained, and weighted least square fits of the low-energy data of each reaction were used to obtain extrapolations of the total cross sections to energies below the experimental range. These cross-section fits were then used to obtain $\overline{\sigma v}$, the Maxwell averaged cross section, for each reaction. (auth)

10930 EFFECT OF PAULI PRINCIPLE IN SCATTERINGS OF TWO CLUSTERS. Saito, Sakae (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 40: 893-4(Oct. 1968).

The characteristic inner oscillations in the $\alpha-\alpha$ scattering solutions are studied, and a model for taking into account the Pauli principle is outlined. (D.C.W.)

10931 AN EXPERIMENTAL TEST OF THE IMPULSE APPROXIMATION AT 200 MeV. Brown, Charles Nelson. New York, Univ. of Rochester, 1968. 132p.

Thesis.

Inelastic p-d interactions have been studied at 200 MeV by bombarding a target of liquid deuterium with a 92% polarized proton beam. The directions and energies of two scattered protons were measured using thick plastic scintillation counters. Three cross sections were studied in detail: the total single arm charged particle yield, $(d\sigma/d\Omega)\ \tau\sigma\tau$; the double arm coincidence rate between two protons, $d\sigma/d\Omega_1 d\Omega_2$; and a fully differential cross section, $d\sigma/d\Omega_1 d\Omega_2 dE_1$. These measured cross sections are compared with the predictions of two impulse approximation formulations: the spectator model, and a more complete calculation including final-state interactions. A semi-relativistic formulation of the spectator model is given which disagrees with published nonrelativistic calculations by 10 to 15% (Kuckes et al., Ann. Phys., 15: (193) (1961)). The final-state interaction calculation is outlined fully. The single arm yield, $(d\sigma/d\Omega)\ \tau\sigma\tau$, was measured for lab angles from 20 to 55°. The spectator model predicts that the cross section $(d\sigma/d\Omega)\ \tau\sigma\tau$ is the sum of the free p-p and p-n cross sections and that the asymmetry of this cross section is the weighted sum of the free p-p and p-n polarizations. The cross section is fit statistically very well but the polarization is fit qualitatively only. The final-state interaction model predictions differ only slightly from the spectator model in the direction which tends to worsen the fit for both the cross section and the asymmetry. The double arm coincidence cross section, $d\sigma/d\Omega_1 d\Omega_2$, is dominated by the contribution of quasifree p-p scattering. The observed cross section is consistently lower than the spectator model prediction near the quasifree peak. At the top of the quasifree peak, the kinematic configuration where the neutron energy is zero, the cross section defect of the measurement from the spectator model is 14%. Data of Kuckes et al., at 145 MeV were reanalyzed in terms of our theory and gave an 18% defect at the top of the quasifree peak. The final-state interaction model accounted for about one-half of the defect in both cases. The shape of the fully differential spectra, $d\sigma/d\Omega_1 d\Omega_2 dE_1$, was predicted well by both models near the quasifree peak. For large included angles the shape of the spectra, $d\sigma/d\Omega_1 d\Omega_2 dE_1$, departed completely from the predictions of the spectator model. Enhancements were seen in kinematic regions where there was a low relative momentum between 2-nucleons in the final state, i.e., a region of final-state interactions. The final-state interaction model accounted for these enhancements qualitatively. The final-state interaction in these regions is sensitive to the short-range behavior of the s-wave interaction of two nucleons, and further experiments could throw light on this problem. Some further results are given on the "singlet deuteron," another manifestation of the final-state interactions. (Diss. Abstr.)

10932 THEORETICAL ANALYSIS OF REACTIONS OF THE (p,pd) TYPE. Kolybasov, V. M.; Smorodinskaya, N. Ya. JETP Lett. (USSR) (Engl. Transl.), 8: 206-8(Sept. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Rekaktsiyu, 8: 335-7(Sept. 20, 1968).

The reactions ^{4}He(p,pd)^{3}H and ^{16}O(p,pd)^{14}N at 1 GeV were analyzed by the pole diagram method. The momentum spectra for emitted deuterons were determined by the pole diagram plus a a constant which approximated a diagram varying slowly as a function of momentum transfer. The magnitude of this constant was determined from the available experimental data. (J.W.R.)

10933 POLARIZATION OF NEUTRONS FROM THE ^{2}H(d,n)^{3}He REACTION BETWEEN 90 AND 175 keV. Prade, H.; Csikai, J. (Inst. of Nuclear Research, Debrecen, Hungary). Nucl. Phys., A123: 365-8(1969).

The polarization of neutrons produced in the ^{2}H(d,n)^{3}He reaction was measured for five deuteron energies between 92 and 173 keV, with a thick TiD target at angles near 50° lab. The measurements were performed with a cloud chamber and with the associated-particle method. The polarization varies strongly in the energy range investigated. The results support the Wills' phase shifts. (auth)

10934 EFFECT OF NUCLEAR DEFORMATION ON FAST-NEUTRON TOTAL CROSS SECTIONS. Glasgow, Dale W.; Foster, D. Graham Jr. (Battelle-Northwest Lab., Richland, Wash.). Contract AT(45-1)-1830. Phys. Rev. Lett., 22: 139-41(Jan. 27, 1969).

The effect of nuclear deformation on the fast-neutron total cross sections was observed for 15 deformed nuclei within the region 152 ≤ A ≤ 189, and five deformed nuclei within the region 228 ≤ A ≤ 240. The phenomenological nonlocal optical model of Perey and Buck disagrees in these regions with the experimental data. (auth)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstracts 9511, 9726, 10905, 10912, 10928, 10929, 10932, 10934, 10985, 10994, and 11066.

10935 (CEA-R-3575) STUDY OF THE REACTIONS ^{9}Be(p,α)^{6}Li, ^{9}Be(p,d)^{8}Be FROM 300 keV TO 900 keV. Bertrand, Francoise; Grenier, Gerard; Pornet, Jacqueline (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes Nucleaires). Oct. 1968. 17p. (In French). Dep.

Experimental results concerning the two reactions ^{9}Be(p,α)^{6}Li and ^{9}Be(p,d)^{8}Be from 300 to 900 keV are presented. The angular distribution, excitation, and total cross-section curves are expressed in absolute values after a normalization carried out using results given by Weber, Davis, and Marion. (auth)

10936 (COO-535-591) TECHNICAL PROGRESS REPORT [ON NUCLEAR PHYSICS], NOVEMBER 1, 1967-NOVEMBER 1, 1968. (Colorado Univ., Boulder. Nuclear Physics Lab.). Contract AT(11-1)-535. 101p. Dep. CFSTI.

The experimental research program dealt primarily with the reactions and scattering of protons, deuterons, and ^{3}He on medium-weight and heavy nuclei. Information on the energy levels of a number of nuclei was extracted. The theoretical research program dealt with composite particle scattering theory, Coulomb energies of A = 20 to 42 nuclei, the behavior of collective-model parameters under band splitting, and the asymmetry observed in the line shape of several isobaric analog resonances. Improvements to the

cyclotron facility are reported, as are developments in semiconductor detectors, neutron time-of-flight spectrometers, diffraction spectrometers, isotope separators, conversion electron spectroscopy, reaction product spectrometers, beta spectrometers, and associated electronic equipment. (D.C.W.)

10937 (COO–1120-78) PROGRESS REPORT, 1967–1968. (Kansas Univ., Lawrence. Nuclear Physics Lab.). Sept. 23, 1968. Contract AT(11-1)-1120. 69p. Dep. CFSTI.

The lifetimes of energy levels in ^{15}N from the reaction $^{14}C(p,\gamma)^{15}N$ were measured using the Doppler shift attenuation method. A technique for determining the parity of nuclear states by measuring the linear polarization of γ rays was tested; support for assignments of positive parity to the 10.54- and 10.81-MeV states of ^{15}N was obtained. The reaction $^{32}S(p,\gamma)^{33}Cl$ was investigated between E_p = 1880 and 1920 keV. The branching ratio of the 3.90-MeV state to the 3.35-MeV state of ^{40}Ca was determined. A method for making triple angular correlation measurements by analyzing the energy distributions of γ rays emitted as the final transition of a particle-particle-γ reaction was developed and was tested using the reactions $^{19}F(p,\alpha\gamma)^{16}O$ and $^{15}N(p,\alpha\gamma)^{12}C$. The $^{31}p(^3He,p)^{33}S$ reaction was investigated at 12 MeV; elastic scattering measurements were made at the same energy to define the optical model parameters. The application of the quasiparticle method to two-nucleon problems involving smooth velocity-dependent potentials was studied. A model for odd-odd nuclei was formulated in which the odd neutron and proton are coupled to a symmetric, rotating core. Calculations of the reduced probability of the E0 conversion transition were made for the K shell. The binding energies of the α particle and the triton were calculated using a potential in which the hard core is replaced by a velocity-dependent interaction that becomes highly repulsive for larger relative moments. (D.C.W.)

10938 (COO-1573-40) THE EFFECTS OF A SPIN ORBIT POTENTIAL ON THE REACTION $^{12}C(dp_2\gamma)^{13}C$. Stieglitz, Robert G. (Case-Western Reserve Univ., Cleveland, Ohio. Dept. of Physics). June 1968. Contract AT(11-1)-1573. 103p. Dep. CFSTI.

Thesis.

The distorted-wave Born approximation (DWBA) was applied to the reaction $^{12}C(d,p_2\gamma)^{13}C$. A spin–orbit potential of the form $\vec{\sigma}\cdot\vec{l}\,V_{SO}(r)$, where $V_{SO}(r)$ is a form factor, was included in the optical potentials used to generate the elastic scattering wave functions for the deuteron and proton channels. Equations are presented for the elastic and reaction differential cross sections and polarizations. Equations are derived for the function $W(\theta_\gamma,\phi_\gamma,\theta_p)$ which expresses the correlation between the outgoing proton and the de-excitation gamma rays from C^{13*}(3.68 MeV). A comparison is made with experiment at incident deuteron energies of 2.80, 3.23, and 3.70 MeV. The agreement between theory and experiment is only fair although it should be noted that there are several known resonances in the ^{12}C + d yield in the energy range studied. (auth)

10939 (JINR–E4-4092) MUON CAPTURE BY COMPLEX NUCLEI. Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 29p. Dep.

The value of the muon-nucleon coupling constants derived from muon capture data on hydrogen and light nuclei as well as the problem of the neutron spectrum and angular distribution is discussed. The collective aspects of the giant resonance states are considered. (auth)

10940 (LNF–68/48) DYNAMICAL NUCLEON–NUCLEON CORRELATIONS IN THE ^6Li, ^{12}C, AND ^{16}O NUCLEI FROM ELASTIC ELECTRON SCATTERING. Note No. 413. Malecki, A.; Picchi, P. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). July 26, 1968. 7p. Dep.

The form factors for ^{12}C, ^6Li, and ^{16}O from electron elastic scattering were calculated taking into account short-range nucleon–nucleon correlations. The results indicate that the single correlated pair approximation considerably overestimates the effect of the short-range correlations. (J.W.R.)

10941 (NIJS–R–533) ABSORPTION OF GAMMA RAYS IN FLUORINE AND NITROGEN. Bezic, N.; Brajnik, D.; Jamnik, D.; Kernel, G.; Snajder, J. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). May 1968. 11p. Dep.

The total photoabsorption cross sections of F and N were measured over the energy range from 8 to 31 MeV. The nuclear absorption cross sections were obtained by subtracting previously reported data for the electronic absorption cross sections. The nuclear absorption cross section for F has a very broad giant resonance extending beyond 30 MeV, with considerable strength and structure also under 20 MeV. For N, the cross section consists of a relatively sharp simple peak at 22.5 MeV and appreciable high-energy strength extending beyond 30 MeV. The integrated cross sections for F and N were obtained. (D.C.W.)

10942 (ORNL–4339) A STUDY OF THE $^{11}B(^3He,p)^{13}C$ AND $^{11}B(^3He,^3He)^{11}B$ REACTIONS. Adair, H. L. (Oak Ridge National Lab., Tenn.). Jan. 1969. Contract W-7405-eng-26. 73p. Dep. CFSTI.

The purpose of this experiment was to study the $^{11}B(^3He,p)^{13}C$ and the $^{11}B(^3He,^3He)^{11}B$ reactions. The proton angular distributions were analyzed in terms of the plane-wave stripping theory of Newns, and the optical model was used to fit the elastic scattering data. All the experimental measurements were made with the 5.5-MeV Van de Graaff at the Oak Ridge National Laboratory. The reaction products were observed with silicon surface-barrier detectors. A particle identification system, which identifies the type and energy of the incident particle, was used to facilitate the interpretation of the pulse-height spectra. Proton angular distributions, corresponding to the ground and first excited states of ^{13}C for an incident ^3He energy of 12 MeV and for the ground, first, second, sixth, eighth, ninth, and thirteenth excited states of ^{13}C for an incident ^3He energy of 10 MeV, were obtained. Spin and parity assignments were made for the eighth and thirteenth excited states of ^{13}C for which no values have been reported. The spin and parity assignments for the other groups were consistent with those reported from other experiments. The elastic scattering of ^3He particles was analyzed at 8, 10, and 12 MeV. The experimental results were satisfactorily interpreted in terms of the optical model. (auth)

10943 MEASUREMENT AND ANALYSIS OF THE POLARIZATION OF PROTONS FROM THE $^{12}C(^3He,p)^{14}N$ (g.s.) AND $^{12}C(^3He,p)^{14}N^*$ (2.31 MeV) REACTIONS. Marr, George. Columbus, Ohio, Ohio State Univ., 1968. 215p.

Thesis.

The angular distributions of the polarization of protons from the $^{12}C(^3He,p)^{14}N$ (g.s.) reaction were measured at 10 energies between 2.5 and 5.5 MeV for laboratory emission angles between 10 and 135°. The polarization of protons leading to the 2.31-MeV (fes) state of ^{14}N was also measured at 5 energies between 4 and 5.5 MeV for angles between 10 and 90°. These measurements were made using the double-scattering method, in which the left-right asymmetry of the elastic scattering of protons at an angle of 45° from a 10-atm helium gas target was measured. The g.s. proton polarization exhibits strong variations with bombarding energy over the entire energy region. The fes proton polarization also shows strong energy dependence at about 5.0 MeV, where the polarization appears to undergo a complete sign-reversal at the forward angles. In the present measurements, the extrema observed for the g.s. protons are +0.489 ± 0.054 for 5.5 MeV at 50.2° (lab) and −0.729 ± 0.050 for 4 MeV at 70.1° (lab). The extrema observed for the fes protons are +0.705 ± 0.077 for 4.0 MeV at 20.4° (lab) and −0.482 ± 0.068 for 5.5 MeV at 30.5° (lab). A resonance reaction analysis of the cross section and polarization data was undertaken for both the $^{12}C(^3He,n)^{14}O$ (g.s.) and the $^{12}C(^3He,p)^{14}N$ (g.s.) reactions, using the present polarization measurements and the reported data by Din et al., Kuan et al., and Schaller et al. The data between 2 and 3 MeV is consistent with spin and parity assignments of $^3/_2^-$, $^1/_2^+$, and $^5/_2^+$ for resonances at 2.45, 2.75, and 3.0 MeV, respectively. The limited data between 3 and 4 MeV favors the assignments of $^3/_2^-$ and $^5/_2^+$ for corresponding resonances at 3.3 and 3.6 MeV. The latter spin assignments are in agreement with Ludemann's predictions for these resonances, but have parities opposite to those assigned by Ludemann. A DWBA analysis was made for the $^{12}C(^3He,p)^{14}N^*$ (2.31 MeV) cross section and polarization data between 4 and 5.5 MeV. Qualitative success achieved suggests the possible importance of the direct-reaction mechanism in this energy region. (Disser. Abst.)

10944 THE ELASTIC SCATTERING OF ALPHA PARTICLES BY ^{16}O AND ^{40}Ca AT 5.0 TO 12.5 MeV. John, Joseph. Tallahassee, Florida State Univ., 1968. 146p.

Thesis.

Elastic scattering of alpha particles by ^{16}O was studied in the energy range from 5.0 to 12.5 MeV to investigate the properties of ^{20}Ne compound-nuclear states. Excitation functions were measured in 10-keV steps at fourteen angles ranging from 54.3 to 176.8° in the center of mass system. These measurements provided fourteen point angular distributions in 10-keV intervals. These were supplemented by fifty-six point angular distribution every 100 keV. Each angular distribution was analyzed in terms of partial waves, and the corresponding phase shifts were extracted from the final fits. The phase shifts are relatively smooth as a function of energy exhibiting a change through nearly 180° in the vicinity of resonances corresponding to that particular partial wave. Twenty-five resonances were identified, and unambiguous

resonance parameters assigned to each of them. Most of the spins and parities are in agreement with previous assignments. Several tentative assignments made in previous experiments were confirmed. Six new states, which have not been previously reported, were observed. In several cases previous descriptions were found to be in error and correct parameters were assigned. The measurements and analysis of the cross section for the elastic scattering of alpha particles by ^{40}Ca in the same energy range are also described. Structure observed in the excitation function measured at sixteen angles was much too complicated for a determination of the properties of individual compound-nuclear states. A description of the average cross section in terms of the nuclear optical model was made. The cross section, measured in 10-keV steps, was smoothed using a Lorentzian weighting function. The averaged angular distributions were compared to the predictions of the optical model. Inclusion of a contribution from compound elastic scattering proved necessary to obtain good fits to the experimental data. (Disser. Abstr.)

10945 DIFFERENTIAL CROSS SECTIONS FOR THE CHARGED PARTICLES PRODUCED BY 60-MeV PROTONS ON CARBON, IRON, AND BISMUTH. Bertrand, Fred Edmond Jr. Baton Rouge, La., Louisiana State Univ. Baton Rouge, La., Agricultural and Mechanical Coll., 1968. 288p.

Thesis.

The differential cross sections for the production of proton, deuteron, triton, helium-3, and alpha particles by 60-MeV proton bombardment of ^{12}C, ^{54}Fe, and ^{209}Bi were measured over a secondary energy range from 1 to 60 MeV. The particles were detected in an all-solid state, 3-detector, total absorption counter telescope. The system resolution was ~150 keV (FWHM). Secondary charged particles were identified by both ΔE versus E and flight time versus E methods. Protons, deuterons, tritons, helium-3's and alphas were unambiguously identified over an energy range from 1 to 60 MeV. Data were obtained at 15 to 20 angles between 12 and 160°. The high-energy region of each charged-particle spectrum is dominated by elastic scattering and excitation of discrete nuclear levels, and differential cross sections are presented for 37 of the levels observed. The secondary proton spectra from ^{12}C, ^{54}Fe, and ^{209}Bi, below the region of discrete peaks, exhibit a structureless and nearly flat continuum region which at low energies merges into a peaked, nearly isotropic distribution except in the case of bismuth. The spectra of other secondaries have roughly the same continuum shape as the protons except that only the secondary alpha particles show a strong evaporation peak. The magnitude of the energy-integrated differential cross sections for each particle type is strongly forward peaked and decreases rapidly with increasing angle until a constant magnitude is reached for angles greater than ~120°. The ratio of protons to deuterons is ~10 to 20 : 1 and the ratio of protons to tritons is ~100 to 300 : 1. The elastic differential cross sections are found to agree with optical model calculations. The proton continuum spectra are compared with estimates from a Monte Carlo intranuclear-cascade plus evaporation calculation. The observed proton cross sections are larger than the estimates for angles larger than ~70° and for angles smaller than ~20°; however, between 20 and 70° the agreement is with ±30%. More high-energy cross section is measured at back angles than is predicted. Especially for the heavier targets, evaporation calculations do not provide enough high energy cross section for deuterons, tritons, helium-3's, or alphas, even at the largest angles of observation. The continuum proton spectra from the neighboring nuclides ^{54}Fe and ^{56}Fe are found to have equal shapes and cross sections in the energy region above 20 MeV, but ^{56}Fe exhibits a peaked low energy distribution which is only ~70% as intense as the ^{54}Fe distribution. (Diss. Abstr.)

10946 A STUDY OF THE REACTIONS ^{9}Be(^{3}He,^{6}Li)^{6}Li AND ^{9}Be(^{3}He,α)2α. Taylor, Morris Chapman. Houston, Tex., Rice Univ., 1968. 129p.

Thesis.

The three-nucleon transfer reaction ^{9}Be(^{3}He,^{6}Li)^{6}Li was studied at bombarding energies up to 10 MeV. The ^{6}Li particles were identified by an associated particle time-of-flight technique in which the mass of one particle is determined from the product of its energy and flight-time squared, ET^2. Angular distributions at 6, 7, 8, 9, and 10 MeV along with excitation functions at center-of-mass angles of 50, 70, and 90° were measured using two-particle coincidence. The angular distribution data indicate that high angular momentum transfer, $l = 3$ and 4, is involved at the higher energies. Observed cross sections of the order of 5 mb are surprisingly large in view of the high angular momentum transfer. In addition, the ^{9}Be(^{3}He,α)2α reaction was studied in search of final-state interference effects and correlations between the first emitted particle and one breakup particle from the recoil ^{8}Be* system. Two alpha particles were detected in coincidence and energy analyzed, thus completely defining the kinematics of the reaction. There was no evidence for strong interference in the observed data. The angular correlation data are compared with a generalized density of states calculation. Excellent fits to the data are obtained when the relative angular momenta of the detected particles are included in the calculation. (Diss. Abstr.)

10947 FINAL STATE INTERACTIONS IN THE ^{9}Be + p → d + 2α REACTION. Emerson, Sidney Thomas. Houston, Tex., Rice Univ., 1968. 107p.

Thesis.

The ^{9}Be + p → d + 2α reaction was studied at a proton bombarding energy of 9.0 MeV, by the coincident detection of pairs of reaction products. Mass identification of one detected particle was accomplished using a time-of-flight technique. The spectra exhibit strong final-state interactions through the ground state and first excited state of ^{8}Be, and through the first excited state of ^{6}Li. Theoretical fits to the data using the generalized density of states functions reproduce quite accurately the shapes of the spectra. Efforts to fit the angular dependence of the yield met with limited success. The reaction yield was shown to be dominated by final-state interactions through states in ^{8}Be and ^{6}Li, with little or no yield from direct three-body disintegration. (Diss. Abstr.)

10948 A STUDY OF THE ^{7}Li(p,n) REACTION IN THE IMPULSE APPROXIMATION. Mahalanabis, J. (Saha Inst. of Nuclear Physics, Calcutta). J. Phys. A (London), 2: 66-74(Jan. 1969).

The (p,n) reaction in ^{7}Li at 94 MeV was studied in the impulse approximation. The differential cross sections for exciting the isobaric analogue state and the 0.431-MeV state in ^{7}Be were obtained using LS-coupled shell-model wave functions. Fairly good shape agreement with the available experimental results was obtained. These results are discussed, together with the inelastic proton scattering to the 0.478-MeV state in ^{7}Li, as a mode of investigating the model wave functions used, where the small-angle results as predicted by the theory appear to be in conflict with the experimental data. Need for more experimental data at small angles for these reactions is stressed. (auth) (UK)

10949 ELASTIC SCATTERING OF DEUTERONS FROM ^{10}B AT LOW ENERGIES. Lombaard, J. M.; Friedland, E.; Verleger, H. (Univ. of Pretoria). Z. Phys., 219: 124-30(1969). (In German).

The excitation curve for the elastic scattering of deuterons from ^{10}B in the energy range from 1.0 to 2.0 MeV was measured at $\theta_L = 135°$. Strong indications for compound-nucleus resonances in ^{12}C at bombarding energies of approximately 1.0 and 1.9 MeV were observed. Angular distributions from 80 to 175° were determined in 200-keV steps from 1.0 to 2.0 MeV. Optical model analyses were made both for volume absorption and surface absorption potentials. Reasonable fits were obtained at energies up to 1.6 MeV with one set of parameters in both cases, while for the higher energies strong deviations were found with the same parameters. (auth)

10950 ELASTIC SCATTERING OF ^{16}O ON ^{9}Be, ^{10}B, AND ^{12}C. Krubasik, E.; Voit, H.; Blatt, E.; Helb, H.-D.; Ischenko, G. (Univ., Erlangen-Nuremberg, Ger.). Z. Phys., 219: 185-200 (1969). (In German).

The differential cross sections of the elastic scattering of ^{16}O on ^{9}Be, ^{10}B, and ^{12}C were measured on-line in the energy range from 26.0 to 32.5 MeV. The reaction products were identified by a dE/dx−E counter telescope. The experimental results were analyzed with the aid of the McIntyre model and the optical model. The mutual dependence of the parameters and their influence on the reflection coefficients were investigated within the frame of the optical model. The boundary form of the potentials proved as an essential parameter of the fit. The calculations demanded a description with a very deep absorption potential, which gives the optical model the characteristic features of a diffraction model. The angular distributions at larger angles for ^{16}O + ^{10}B and ^{16}O + ^{12}C could be interpreted as contributions of transfer reactions. (auth)

10951 PRIMARY ENERGY ESTIMATION IN INTERACTIONS OF 22.8-GeV/c PROTONS WITH NUCLEONS AND LIGHT EMULSION NUCLEI. Bhowmik, B.; Shivpuri, R. K. (Univ. of Delhi). Can. J. Phys., 47: 195-8(Jan. 15, 1969).

The validity of the Castagnoli's formula was tested for primary energy estimation in the case of p−N and p-light nucleus collisions. By eliminating the contribution of the persisting primary in the angular distribution, a better estimate of the primary energy was obtained. In the case of p−N collisions, a good agreement with the actual value of the primary energy was obtained for $n_s > 4$ events and a large disagreement for $n_s \leq 4$ events. The latter observation was explained on the basis of a peripheral mechanism of particle production for such events. In the case of p-light

nucleus collisions, the underestimation of the primary energy for high-multiplicity events was explained as being due to the occurrence of secondary collisions inside the nucleus. (auth) (Canada)

10952 SEARCH FOR WIDTH VARIATIONS OF SHORT-LIVED STATES FORMED IN THREE-BODY REACTIONS. Nuesslin, F.; Zimmerer, J.; Martis, K. W.; Werner, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys., A123: 300-4(1969).

In order to determine the level parameters of the first excited state of ^{8}Be different three-body reactions, with ^{8}Be as an intermediate system were investigated in complete experiments. A systematic change of the resonance width with the relative velocity of the spectator, which was assumed by Berkowitz, could not be proved. The resonance width and energy were found to be $\Gamma = 1.75 \pm 0.30$ MeV and $E_{res} = 2.83 \pm 0.20$ MeV, respectively. (auth)

10953 COULOMB DISTORTION EFFECTS IN LARGE-ANGLE M1 ELECTROEXCITATION. Chertok, B. T.; Johnson, W. T. K. (American Univ., Washington, D. C.). Phys. Rev. Lett., 22: 67-70(Jan. 13, 1969).

A reanalysis of inelastic electron-scattering measurements from giant M1 states in ^{28}Si and ^{12}C and in ^{26}Mg was made using Coulomb-distortion corrections in place of the plane-wave Born-approximation analysis. It is shown that the corrections even for light nuclei can reduce the nuclear form factors for M1 transitions outside the experimental error quoted in the plane-wave Born approximation analysis of electron scattering. This reduction in B(M1,q) is magnified at the photon point. (auth)

10954 SPECTROSCOPIC FACTORS FOR ^{19}F FROM THE ^{18}O(^{3}He,d)^{19}F REACTION. Lennon, C. O.; Alderson, P. R.; Durell, J. L.; Green, L. L.; Naqib, I. M. (Liverpool Univ.). Phys. Lett., 28B: 253-5(Dec. 9, 1968).

Spectroscopic factors for states in ^{19}F were determined from the ^{18}O(^{3}He,d)^{19}F reaction. They are compared with recent independent-particle model and rotation-particle coupling model calculations for this nucleus. (auth)

10955 INTENSITIES OF MESONIC 2p–1s X-RAYS IN N, ^{16}O, ^{18}O, F, AND Na. Koch, H.; Poelz, G.; Schmitt, H.; Tauscher, L.; Backenstoss, G.; Charalambus, S.; Daniel, H. (CERN, Geneva. Max-Planck-Institut fuer Kernphysik, Heidelberg. Univ., Karlsruhe, Ger.). Phys. Lett., 28B: 279-81(Dec. 9, 1968).

The yields of pionic and muonic 2p–1s X-rays are given for N, ^{16}O, ^{18}O, F, and Na. The populations of the pionic 2p levels are determined and the natural widths are deduced. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 9726, 9730, 9739, 10759, 10905, 10928, 10934, 10936, 10937, 10939, 10944, 10947, 10953, 10955, and 11074.

10956 (BNL-tr-227) MEASURING ANGULAR DISTRIBUTIONS OF 0.3-, 0.5-, AND 0.8-MeV NEUTRONS ELASTICALLY SCATTERED ON NUCLEI OF TITANIUM AND COBALT. Korzh, I. O.; (and others) (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Fiziki). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from a report. 7p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 12009. (TSS)

10957 (BNL-tr-228) DIFFERENTIAL CROSS SECTIONS OF ELASTICALLY SCATTERED NEUTRONS ON Si, Cr, Zr, Rb, AND Bi. Korzh, I. O.; Sklyar, M. T.; Totskii, I. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Fiziki). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from a report. 6p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 19: 5238. (TSS)

10958 (BNL-tr-232) ANGULAR DISTRIBUTION OF 0.3-MeV NEUTRONS ELASTICALLY SCATTERED BY ATOMIC NUCLEI. Korzh, I. O.; Sklyar, M. T. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Fiziki). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from a report. 5p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 18: 17090. (TSS)

10959 (BNL-tr-242) ELASTIC SCATTERING OF 0.65-MeV NEUTRONS BY ATOMIC NUCLEI. Korzh, I. O.; (and others) (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Fiziki). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from a report. 8p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 18: 17089. (TSS)

10960 (JINR-P3-4152) NEUTRON RESONANCES OF ^{69}Ga AND ^{71}Ga ISOTOPES. Malecki, H.; Pikelner, L. B.; Salamatin, I. M.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1968. 14p. (In Russian). Dep.

Radiative capture, self-indication, and transmission measurements were performed on enriched ^{69}Ga and ^{71}Ga isotopes by the time-of-flight method using the pulsed reactor IBR with a microtron. The parameters of the isolated resonances were obtained in the energy range up to 5 keV. For 18 resonances of both isotopes, spins J were determined. The obtained values of the strength functions $S_0(J)$ agree for two spin states within the statistical errors. (auth)

10961 (NP-17704) ANNUAL REPORT, APRIL 1967–MARCH 1968. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 92p. Dep.

ALUMINUM-27—proton inelastic scattering at 55 MeV, angular distributions for, (E)
—energy levels from proton inelastic scattering, collective, (E)
ANTIMONY-121—separation of, at Institute for Nuclear Study of University of Tokyo
ANTIMONY-123—separation of, at Institute for Nuclear Study of University of Tokyo
BARIUM-138—helium-3 reactions (He-3,d) with, angular distributions for, (E)
BETA SPECTROMETERS—fabrication of air-cored, of 75 cm radius
CADMIUM-116—helium-3 reactions (He-3,d) with, angular distributions for, (E)
CARBON-12—helium-3 reactions (He-3, Be-7) and (He-3, Li-6) at 25 and 28 MeV, angular distributions for, (E)
CARBON-13—separation of, at Institute for Nuclear Study of University of Tokyo
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COPPER-58—energy levels from nickel-58 (p,n) reactions, (E)
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—detection and measurement of, performance of airborne emulsion chambers for
COSMIC SHOWERS—detection and measurement of, operation of multidetector apparatus for
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—density distribution measurements of
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GADOLINIUM-152—energy levels in vibrational bands, (E)
GADOLINIUM-156—energy-level transitions from terbium-156 decay, (E)
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IRON-54—helium-3 reactions (He-3,d) with, angular distributions for, (E)
LANTHANUM-139—energy levels from barium-138 (He-3,d) reactions, (E)
LEAD-204—separation of, at Institute for Nuclear Study of University of Tokyo
MAGNESIUM-24—separation of, at Institute for Nuclear Study of University of Tokyo
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—helium-3 reactions (He-3,p) at 27 MeV, proton spectra from, (E)
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MAGNESIUM-26—separation of, at Institute for Nuclear Study of University of Tokyo
—proton inelastic scattering at 55 MeV, angular distributions for, (E)
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—proton elastic and inelastic scattering at 12 MeV, using polarized beams, asymmetry measurements for, (E)
SILICON-29—separation of, at Institute for Nuclear Study of University of Tokyo
SILICON-30—separation of, at Institute for Nuclear Study of University of Tokyo
SILVER-109—separation of, at Institute for Nuclear Study of University of Tokyo
SYNCHROTRONS—development of proton, for Institute for Nuclear Study of University of Tokyo
TRITIUM—deuteron reactions (d,n) with, differential cross section for, (E)
TUNGSTEN-182—separation of, at Institute for Nuclear Study of University of Tokyo
TUNGSTEN-183—separation of, at Institute for Nuclear Study of University of Tokyo
TUNGSTEN-184—separation of, at Institute for Nuclear Study of University of Tokyo
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X RADIATION—absorption measurements in gases and solids, use of synchrotron radiation for soft x-ray (D.C.W.)

10962 (NP-tr-1719) NEUTRON CROSS SECTIONS AND STRENGTH FUNCTIONS FOR GERMANIUM ISOTOPES. Malecki, H.; Pikel'ner, L. B.; Salamatin, I. M.; Sharapov, E. I. Translated by E. F. Towndrow (Atomic Energy Research Establishment, Harwell, Eng.), from report JINR-P-3-3456. 12p. Dep. CFSTI.

Neutron resonance parameters and strength functions for the Ge isotopes were determined from radiate capture, self-indication, and transmission measurements by the time-of-flight method. Level parameters were also calculated. Potential scattering cross sections were determined for the energy range 3 to 1000 eV. The data was in fair agreement with theoretical values and other experimental data. (J.W.R.)

10963 (UCRL-50440) CORRELATION MEASUREMENTS OF CIRCULARLY-POLARIZED GAMMA RAYS FOLLOWING BETA DECAY OF ^{55}Co AND ^{52}Mn. Sawyer, Jerry A. (California Univ., Livermore. Lawrence Radiation Lab.). June 1968. 196p. Dep. CFSTI.

The β–γ, circularly polarized (CP), correlation was measured in the decays of ^{55}Co and ^{52}Mn using the gamma-ray Compton scattering technique for ^{55}Co and the photon transmission technique for ^{52}Mn. Circular polarization of the gamma rays was measured by observing the change in the beta-gamma coincidence rate resulting from the dependence of the photon-electron scattering cross section on the relative orientation of the photon and electron spins. Approximately 7.9% of the electrons were polarized in magnetized iron, the medium in which photon-electron scattering occurs. The correlation measurement yielded an asymmetry parameter, designated as A, which depends upon the states involved and their nuclear properties. The nuclear properties were expressed quantitatively as the matrix elements (Fermi, Gamow-Teller, charge-dependent) of the beta-interaction operators and as the electromagnetic multipole operators (EL/ML) between the states involved in the beta-gamma cascade. Because the matrix elements also were a function of the spins of the states involved, measurements were made to determine the spin, as in the ^{55}Co measurement. Single-particle shell model theory assigns $7/2^-$ for the ground-state spin (g.s.) of ^{55}Co. Inasmuch as the ground-state spin of $7/2^-$ has not been confirmed experimentally and because the closed shell properties are of basic importance ($^{55}_{27}Co_{28}$ has a proton hole in a doubly closed shell), A was measured for the ^{55}Co β–γ cascade ($7/2^- \xrightarrow{\beta} 5/2^- \xrightarrow{\gamma} 3/2^-$ g.s.) using the scattering polarimeter. The ^{55}Co results indicated that $7/2^-$ is the only reasonable assignment for the ground-state spin, the radiative mixing parameter (δ = E2/M1) for the 931-keV gamma transition in ^{55}Fe ($7/2^- \xrightarrow{\gamma} 3/2^-$ g.s.) is $+0.42 \pm 0.04$ (the average of this work and other experimental values found in the literature yields $\langle\delta\rangle = 0.39 \pm 0.03$, and the spin of the 1316-keV excitation level in ^{55}Fe ($7/2^- \xrightarrow{\beta} 7/2^- \xrightarrow{\gamma} 3/2^-$ g.s.) has a preferred assignment of $7/2^-$. Because of the difficulty in separating the spin possibilities experimentally, the value of $5/2^-$ can not be definitely excluded. The ^{55}Co results were corrected for non-zero instrumental effects ($A = +0.007 \pm 0.003$) and normalized to ^{60}Co and ^{56}Mn ($A = -1/3$ for a pure Gamow-Teller transition). The published values of A for ^{52}Mn do not overlap. In fact, they span a range from 0 to -0.16. Because ^{52}Mn is a mixed β transition ($6^+ \xrightarrow{\beta} 6^+$), it can have both Fermi (M_V) and Gamow-Teller (M_A) matrix elements. The charge-dependent matrix element (H_c), corresponding to M_V ranges from 3 to 61 keV, raises a significant question as to the degree of conservation of the isospin quantum number T in ^{52}Mn. To resolve this problem, the value of A for ^{52}Mn was measured using a method never used before for this nucleus, the transmission polarimeter technique. The transmission experiment resulted in measurement of the circular polarization of the transmitted photons in contrast to the scattered photons in the ^{55}Co experiment. The transmission experiment on ^{52}Mn produced a value of $A = -0.027 \pm 0.009$, which agreed closely with two recent scattering and two oriented nuclei experiments, but disagreed significantly with results obtained before 1965. When the results of this study were averaged with the previous experiments, the following values and matrix elements were obtained for ^{52}Mn: $\langle A\rangle = -0.025 \pm 0.002$; the matrix element ratio $\langle y\rangle = -0.042 \pm 0.003$, which agrees well with the Kelly and Moszkowski theoretical value (of -0.04; the Fermi matrix element $\langle M_V\rangle = (5.81 \pm 0.47) \times 10^{-3}$; the isospin impurity coefficient $\langle\alpha\rangle = (2.91 \pm 0.24) \times 10^{-2}$; and the charge-dependent matrix element $\langle H_c\rangle = 17 \pm 1.3$ keV. These new values should help considerably in resolving the experimental contradictions for ^{52}Mn. In addition, ^{52}Mn results were corrected for non-zero instrumental effects ($A = +0.005 \pm 0.004$) and normalized to ^{60}Co. (auth)

10964 LIFETIMES AND DECAY OF THE 2.07-MeV TRIPLET IN ^{28}Al. Haeusser, O. (Chalk River Nuclear Labs, Ontario); Anyas-Weiss, N. Can. J. Phys., 46: 2809-14(Dec. 15, 1968).

Gamma rays from resonances at E_p = 956, 1199, 1287, and 1701 keV in the reaction ^{25}Mg(p,γ)^{26}Al were studied using 40-cm^3 and 25-cm^3 Ge(Li) detectors. Accurate γ-ray energy determinations and Doppler shift measurements indicate the existence of three levels at excitation energies of 2068.7, 2069.5, and 2071.7 keV. The level at 2068.7 keV has a mean lifetime of 3.8×10^{-13} s and decays 29% to the ground state, and 71% to the 416.6 keV level. The 2069.5 keV level has a mean lifetime of $1.3 \pm 0.5 \times 10^{-14}$ s and decays 5% to the 228.2-, 22% to the 416.6-, and 73% to the 1057.7-keV levels. The level at 2071.7 keV has a lifetime of 5.6×10^{-13} s and decays to the 228.2-keV (>65%) and the 1057.7-keV (<35%) levels. An upper limit of $\tau < 10^{-14}$ s was placed on the lifetime of the 3159.4-keV level, and the mean lifetime of the 1850.8-keV level was measured to be $1.6 \pm 0.7 \times 10^{-14}$ s. (auth) (Canada)

10965 14.8 MeV NEUTRON ACTIVATION CROSS SECTIONS OF ARGON, CHROMIUM, RHODIUM, AND TELLURIUM. Husain, Liaquat. Fayetteville, Ark., Univ. of Arkansas, 1968. 90p. Thesis.

The (n,^{3}He) and (n,2p) reaction on ^{103}Rh with 14.8-MeV neutrons were shown to occur. Activation cross-sections were measured using radiochemical separations and low-level counting techniques

for Ar, Cr, Rh, and Te isotopes. The validity of the empirical formulations of Levkovskii, Gardner, and Bayhurst and Prestwood, based on statistical theory, has been checked by comparing the calculated values with measured cross sections. Bayhurst and Prestwood's equation was modified to give a better fit to the experimental data. A major part of the nuclear reactions with 14 to 15 MeV neutrons seems to proceed via the compound nucleus. (Diss. Abstr.)

10966 PROPERTIES OF THE 4.038-MeV STATE IN ^{25}Al. Roepke, H.; Anyas-Weiss, N.; Litherland, A. E. (Univ. of Toronto). Can. J. Phys., 46: 2789-96(Dec. 15, 1968).

The 4.038-MeV state in ^{25}Al, which is also the E_p = 1.824 MeV resonance in the ^{24}Mg(p,γ) reaction, was investigated using the ^{24}Mg(p,γ) reaction. The γ-ray decay scheme is given and a limit of $\Gamma_{p'} \leq 0.1\ \Gamma_\gamma$ is obtained for the inelastic proton scattering width. Angular distribution measurements of de-excitation γ rays confirm previous values of radiation mixing ratios, but can not remove the $J^\pi = 3/2^+, 5/2^+$ ambiguity in the spin-parity assignment. A Doppler shift attenuation measurement of the 4.038-MeV deexcitation γ ray yields $f(\tau) = 0.91 \pm 0.02$, corresponding to a lifetime of $\tau(4.038) = 22 \pm 6$ fs. The particle widths are derived using the lifetime and a previous measurement of the γ-ray yield at the ^{24}Mg, E_p = 1.824 MeV resonance. On the basis of the particle width, arguments are given for a $J^\pi = 5/2^+$ assignment to the 4.038-MeV state. (auth) (Canada)

10967 STUDIES OF THE MECHANISM OF NUCLEAR REACTIONS. Wiktor, S. (Inst. of Nuclear Physics, Krakow). PTJ, 11: 173-6(1967). (In Polish).

Some two-nucleon transfer reactions, (d,α) and (α,d), were investigated in view of the preservation of spin allignment and isobaric spin. Using an α-particle beam with an energy of 24.7 MeV and a deuteron beam with an energy of 12.9 MeV, the reactions ^{40}Ca(α,d)^{42}Sc, ^{50}Ti(d,α)^{48}Sc, and ^{12}C(d,α)^{10}B were studied. It was found that the states of residual nuclei produced in these reactions are presumably two-particle states with the highest possible spins and not changed isobaric spin values. Excitations of such states can be explained by a simple stripping and pick-up of a correlated pair of nucleons. (auth) (NSA of Poland)

10968 ELECTROMAGNETIC SCATTERING OF NEUTRONS. Hogan, William Sanford. Columbus, Ohio, Ohio State Univ., 1968. 172p.

Thesis.

The influence of the interaction between the magnetic moment of a neutron and the Coulomb field of a target nucleus or a target proton is investigated. In the case of a target nucleus, a formalism is developed whereby the interaction can be treated exactly in optical model calculations. Heretofore all treatments of this effect had their basis in the Born approximation, and the influence of the effect was believed to be confined to relatively small scattering angles. Calculations done here at energies of 0.5, 1, 7, 14.5, and 24 MeV for Al, Mn, Nb, and Bi indicate that treatment of that part of the problem associated with the electromagnetic interaction can be treated adequately by the Born approximation. It was also found that this interaction could influence neutron polarizations at relatively large angles that correspond to minima in the differential cross section. Influence on the differential cross section was found to be confined to scattering angles less than 2°. The effect of the electromagnetic interaction on p-wave resonances was investigated and found to be negligibly small. It is pointed out that for proton targets the character of the interaction changes and total spin is no longer a good quantum number. A formalism is developed which includes the resulting singlet-triplet mixing. The scattering amplitude matrix is derived and forms for the matrix elements and Wolfenstein parameters obtained. The nine most common nucleon–nucleon scattering parameters are found including the effects of singlet-triplet mixing. The radial wave equations are found, and those coupled equations representing the l = j singlet and triplet states are solved through a distorted-wave approximation. Calculations were performed over an energy range from 25 to 210 MeV using nuclear phase shifts previously determined from best chi-squared fits to scattering data. These calculations indicate that any significant electromagnetic force influence is confined to very small scattering angles and that the influence is large in these regions. The effect of the electromagnetic force on the binding energy of the deuteron was estimated and found to be small. (Diss. Abstr.)

10969 PRODUCTION OF ^{8}Be IN 20-GeV/c PROTON INTERACTIONS WITH THE HEAVY NUCLEI OF NUCLEAR EMULSION. Deka, G. C.; Deka, K. C. (Cotton Coll., Gauhati, India). Can. J. Phys., 47: 227-31(Jan. 15, 1969).

An analysis of 271 collimated pairs of alpha particles of comparable ranges emitted from interactions of 20-GeV/c protons with the heavy nuclei of emulsion was made; ~90% of these can be interpreted as due to the decay of ^{8}Be in its ground state. The mean Q-value (~0.094 MeV) obtained from the analysis is in good agreement with the expected Q-value of the reaction $^8\text{Be} \rightarrow 2\ ^4\text{He}$. The energy and angular distributions of the ^{8}Be nuclei were compared with the predictions of the nuclear "evaporation" theory. The parameter values for good fit are found to be: T = 10 MeV, V = 10 MeV, and β = 0.015. (auth) (CANADA)

10970 INTERPRETATION OF THE ISOMER SHIFT OF ^{57}Fe. Dautov, L. M.; Kaipov, D. K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, No. 2, 1-6(1968). (In Russian).

A systematic analysis of the contributions of 3d and 4s electrons to the total density of orbital electrons in the field at the site of a nucleus was made for some elements of the first transition region. On the basis of the analysis, an expression was obtained for the change in the charge radius of the nucleus ^{57}Fe upon excitation to the 14.4-keV level. (tr-auth)

10971 A STUDY ON THE YIELD OF (γ,α) REACTIONS WITH 20 MeV BREMSSTRAHLUNG. Oka, Yoshinaga; Kato, Toyoaki; Nomura, Koichi; Saito, Tatsuya; Tsai, Hui-tuh (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap., 41: 2660-2(Nov. 1968).

The yields of the (γ,α) reactions on 7 elements up to an atomic number of 49, irradiated with 20 MeV bremsstrahlung were obtained through γ-spectrometric measurements of the resultant activities. The yield values, as measured in absolute disintegration rates at the end of irradiation per mole per R, were plotted against atomic number of the target nuclides. The yield curve shows a maximum in the region of copper and zinc, and drops rapidly with increasing atomic number. The shape of this yield curve is similar to that for the photoalpha yield as a function of atomic number. It can be seen that yield levels off in the region of silver and indium. A mechanism such as the direct photoelectric effect is thought to be responsible for this behavior. The yield of the (γ,α) reaction of an element amounts to only a small fraction, at most a few tenths of a percent, of the total photonuclear yield. (auth)

10972 EXCITATION FUNCTIONS, RECOIL ION RANGES, EQUILIBRIUM, AND NONEQUILIBRIUM STATISTICAL ANALYSIS OF REACTIONS INDUCED IN ^{27}Al AND ^{51}V BY 7 TO 120 MeV ^{4}He IONS. Bowman, Wilfred William. New York, Univ. of Rochester, 1968. 123p.

Thesis.

The excitation functions and recoil ion ranges for ^{54}Mn, ^{52}Mn, ^{51}Cr, ^{48}V, ^{47}Sc, ^{46}Sc, and ^{44m}Sc and the excitation function for ^{48}Sc resulting from the bombardment of ^{51}V, and the excitation functions and recoil ion ranges for ^{24}Na and ^{22}Na resulting from the bombardment of ^{27}Al with 7- to 120-MeV ^{4}He ions were measured. By comparisons with the theoretical ranges of Lindhard, Scharff, and Schiott, the measured recoil ion ranges were found to indicate symmetric particle emission for energies up to and including the peak of the excitation functions, and asymmetric particle emission for higher energies. Four types of calculations were performed for comparisons with the experimental excitation functions. The first calculation used the standard Weisskopf evaporation formalism with a standard Fermi gas level density expressed by $\rho(U) \propto U^{-2} \exp(2(aU)^{\frac{1}{2}})$ where U is the thermodynamic excitation energy appropriately corrected by the pairing energy. This calculation was repeated to include the appropriate shell closure corrections suggested by Rosenzweig and by Newton, with results which demonstrate better agreement with experiment for the Rosenzweig model than for either the Fermi gas or Newton model. The second type of calculation explicitly treated the effects of angular momentum by allowing for a removal of angular momentum by the evaporated particles, through use of a spin-dependent level density expression, $\rho(U,J) \propto (2J+1)U'^{-2} \exp(2(aU')^{\frac{1}{2}})$ where U' is the thermodynamic excitation energy (pairing corrected) reduced by the classical rotation energy for each value of J using the rigid body moment of inertia. The third type of calculation, the so-called "s-wave approximation," did not allow for the removal of angular momentum by the emitted particles, thus preventing a change in the spin distribution throughout the evaporation process. This approximation provides an upper limit to the effects of angular momentum. In both the second and third types of calculation, it is assumed that when the excitation energy, U', of a nucleus is less than the binding energy of the least tightly bound nucleon, the classical rotational energy corresponding to the J value of that nucleus is dissipated through the emission of gamma rays. The results of these calculations demonstrate an ability of the compound statistical model to describe, in part, high-energy (≤120 MeV) nuclear reactions, and an inability to reproduce the high-energy tails of the experimental excitation functions. The mass dependence of the effects of angular momentum is also indicated. The fourth types of calculation were based

on the new model of Griffin, wherein particle emission may occur before statistical equilibrium is reached. These results demonstrate a remarkable ability for the calculation of the high-energy tails observed in the experimental excitation functions and a general agreement with the shapes of the experimental excitation functions. (Disser. Abstr.)

10973 SPECTRUM AND ASYMMETRY OF DIRECT NEUTRONS FROM MUON CAPTURE IN CALCIUM. Bogan, Alexander Jr. (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). Phys. Rev. Lett., 22: 71-6(Jan. 13, 1969).

The energy spectrum and asymmetry of neutrons emitted directly following the capture of polarized muons by ^{40}Ca were calculated in a simple nuclear shell model, taking account of terms proportional to the nucleon momentum. The energy spectrum was within the error brackets of recent experiments with the nucleon-momentum terms making a small contribution. The asymmetry coefficient was strongly affected by the inclusion of the momentum-dependent terms and was found to change sign and increase in magnitude with increasing energy, in qualitative agreement with recent experiments. (auth)

10974 NATURE OF 0^+ LEVELS IN CALCIUM ISOTOPES. McGrory, J. B.; Wildenthal, B. H. (Oak Ridge National Lab., Tenn.). Phys. Lett., 28B: 237-9(Dec. 9, 1968).

Conventional shell model calculations of $J = 0^+$ states in the calcium isotopes are discussed. Configurations including four f-p shell single particle orbits are included. The results suggest that the first excited $J = 0^+$ states in ^{42,44,46}Ca are predominantly deformed states. (auth)

10975 OPTICAL-MODEL ANALYSIS OF d-Ca POLARIZATION AND CROSS-SECTION MEASUREMENTS FROM 5 TO 34 MeV. Schwandt, P.; Haeberli, W. (Univ. of Wisconsin, Madison). Nucl. Phys., A123: 401-29(1969).

Vector and tensor polarization parameters were measured for deuterons elastically scattered by ^{40}Ca at 5, 7, 9 and 11 MeV. These data together with polarization data at 22 MeV and all available elastic scattering cross-section data from 5 to 34 MeV were analyzed in terms of the optical model with vector spin-orbit coupling. A potential whose parameters change smoothly with energy describes the cross-section and vector polarization data reasonably well. Calculations performed at 9 and 22 MeV in which a tensor spin-orbit coupling was included gave somewhat better fits to the observed tensor polarizations than were obtained with a vector spin-orbit coupling alone. Some calculations on the ^{40}Ca(d,p)^{41}Ca reaction were also performed to test the usefulness of the deuteron potential found here as a distorting potential in distorted-wave theory. The calculations reproduce qualitatively the observed j-dependence in the stripping cross section. The predicted polarizations of outgoing protons show little similarity to the measurements. (auth)

10976 STUDY OF THE REACTION ^{40}Ca(^{3}He,α)^{39}Ca. Ronsin, G.; Vergnes, M.; Rotbard, G.; Kalifa, J. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A123: 337-47 (1969). (In French).

The (^{3}He,α) reaction on ^{40}Ca was analyzed at several energies using the DWBA method. Optical potentials were found which reproduce the angular distribution of α particles corresponding to the ground and first excited states of ^{39}Ca. Values for the spectroscopic factors of the ground and first two excited states using a normalization constant N = 20 are compared with other experimental and theoretical values. A rather large disagreement is observed for the ground state of ^{39}Ca; the spectroscopic factor deduced from the (^{3}He,α) reaction is not independent of the incident energy. The value obtained at $E_{^3He}$ = 8 MeV is much too large. (auth)

10977 DECAY OF ^{89}Zr AND ^{89m}Zr AND LEVELS OF ^{89}Y. Robinson, E. L. (Oak Ridge National Lab., Tenn. Univ. of Alabama, Birmingham); Hagenauer, R. C.; Eichler, E. Nucl. Phys., A123: 471-6(1969).

The decay of the ^{89}Zr isomers was restudied using Ge(Li) detectors. Gamma rays were observed from the 78.0-hr ground state with energies in keV (and intensities) of 909.2 (100), 1620.8 (0.071), 1657.3 (0.10), 1712.9 (0.77), and 1744.5 (0.12). Gamma-ray energies (and intensities) observed from the decay of 4.16-min ^{89m}Zr are 587.8 (100) and 1507.4 (7.19). (auth)

10978 K-BAND MIXING AND 8p-8h STATES IN ^{40}Ca. Gerace, W. J.; Green, A. M. (Princeton Univ., N. J.). Nucl. Phys., A123: 241-9(1969).

K-band mixing and higher order deformed states are introduced into an earlier multiparticle-multihole model of ^{40}Ca. The inclusion of these states enables the model to explain certain experimental data which the simplified model could not explain. In particular, K = 2 4p-4h states are needed to account for the decay of the 5.24 MeV, 2^+ state. The 5.20 MeV 0^+ state is interpreted as the first member of an 8p-8h deformed rotational band. (auth)

10979 GAMMA-RAY BRANCHING RATIOS OF THE LOW-LYING LEVELS OF ^{29}Al. Kean, D. C.; Carter, K. W.; Spear, R. H. (Australian National Univ., Canberra). Nucl. Phys., A123: 430-6(1969).

A 12.7 × 10.2 cm NaI(Tl) gamma-ray spectrometer was used in conjunction with a 61-cm magnetic particle spectrometer to measure gamma-ray branching ratios for levels in ^{29}Al at excitation energies of 1.76, 2.23, 2.87, 3.07, 3.19, 3.44, and 3.58 MeV. (auth)

10980 ABSOLUTE DETERMINATIONS OF ACTIVATION CROSS SECTIONS FOR 14.7- AND 14.8-MeV NEUTRONS. Crumpton, D.; Cox, A. J.; Cooper, P. N.; Francois, P. E.; Hunt, S. E. (Univ. of Aston, Birmingham, Eng.). J. Inorg. Nucl. Chem., 31: 1-8(Jan. 1969).

Absolute activation cross sections were measured for the reactions ^{63}Cu(n,2n)^{62}Cu, ^{65}Cu(n,2n)^{64}Cu, ^{92}Mo(n,2n)^{91g}Mo, and ^{27}Al(n,α)^{24}Na, using neutrons of average energy 14.7 MeV and 14.8 MeV obtained from the T(d,n)^{4}He reaction using low-energy accelerators. The results were compared with other measurements. The statistical model of the nucleus and evaporation theory were used to calculate the reaction cross sections and their dependence on the energy of the incident neutron, taking into account the spins and angular momenta involved. Good agreement was found between the theoretical and experimental values. (auth) (UK)

10981 ELECTRIC QUADRUPOLE TRANSITIONS IN ^{42}Ca. Hartmann, R.; Lieb, K. P.; Roepke, H. (Univ., Freiburg i. B.). Nucl. Phys., A123: 437-48(1969).

From Doppler shift attenuation and delayed coincidence measurements, lifetimes were determined for states in ^{42}Ca. The measured electric quadrupole transitions were compared with the predictions of the shell model, the weak-coupling model and the Gerace-Green calculations. (auth)

10982 HIGH-RESOLUTION STUDY OF ^{70}Ge. Hinrichsen, P. F. (Franklin Inst., Swarthmore, Pa. Univ. of Pennsylvania, Philadelphia); Van Patter, D. M.; Shapiro, M. H. Nucl. Phys., A123: 250-72(1969).

Inelastic proton spectra from the ^{70}Ge(p, p') reaction at 7.0 Mev were studied with a 65 cm broad-range magnetic spectrograph. The scattered background was reduced by using 0.4 × 8 mm slit targets, and an energy resolution of FWHM = 5.5 keV was achieved. Many closely spaced levels were observed up to 4.1-MeV excitation including a 3.4-keV doublet at 2.16 MeV. Level energies were determined to ±2 keV or better by combining these precise level separations with γ-ray measurements from the ^{70}Ge(p, p'γ) reaction and the ^{70}As(γ)^{70}Ge decay obtained with a 20 cm^3 Ge(Li)-NaI(Tl) coincidence-anticoincidence spectrometer. Available information concerning J^π assignments for levels up to 3.1 MeV is summarized. Comparison of (p, p') yields at 50 and 90° combined with relative (p, p') cross sections provide evidence for probable J = 0 states at 2.31, 2.89, and 3.11 MeV. The octupole 3^-_1 state was assigned at 2562 keV on the basis of its prominent yield at E_p = 10 MeV. The $2^+_2(E2)0^+_2$ transition was observed in ^{70}Ge with a B(E2) value which is a factor of 14 ± 2 larger than that for the $2^+_2(E2)0^+_1$ transition. A nuclear temperature T = 0.7 ± 0.1 MeV was derived from the present data. (auth)

10983 NEUTRON ELASTIC AND INELASTIC SCATTERING FROM ^{56}Fe FROM 4.60 TO 7.55 MeV. Kinney, William Elmer. Knoxville, Tenn., Univ. of Tennessee, 1967. 137p.

Thesis.

Neutron elastic and inelastic scattering cross sections for ^{56}Fe were measured in the energy range from 4.60 to 7.55 MeV by the time-of-flight method in order to study the competition between direct interactions and compound-nucleus decay in the excitation of the 2^+ collective level that has an excitation energy of 0.846 MeV, to test the validity of the statistical model in predicting the cross sections for inelastic scattering to the higher levels, and to obtain optical model parameters from fits to the elastic scattering data. Neutrons were produced by the ^{2}D(d,n)^{3}He reaction in a deuterium gas cell and had an energy uncertainty of 40 keV. The neutrons were scattered by solid right cylindrical samples of natural iron and were detected in a shielded liquid scintillator optically coupled to a phototube whose output, together with a time reference signal, measured the flight time with a typical time resolution for the elastic neutrons of 3 nsec. Gamma rays were discriminated against to decrease the background, and the neutron production of the target was monitored by a simplified time-of-flight detection system. Measurements were made at angles ranging from 25 to 140° with 3.7- to 5.3-m flight paths. Electronic "walk" was corrected by dividing the range of pulse heights of

the detected neutrons into groups, taking a time-of-flight spectrum for each group, and aligning and adding the group spectra. Peak areas were extracted by isolating each peak visually on an oscilloscope screen by means of a light pen operating with a PDP-7 computer program which then computed the area of the isolated peak. The peak areas were combined with detector efficiency measurements, scattering-sample data, and geometric data to produce cross sections which were corrected for finite sample effects by applying factors obtained from a Monte Carlo computer calculation. Optical model minimum χ^2 fits were made to the elastic-scattering data, with the real and imaginary well depths varied to achieve the best fits and the other parameters held constant at standard values. Optical model calculations with average values of 46.6 and 11.8 MeV for the real and imaginary well depths, respectively, were in reasonable agreement with experiment from 4.0- to 7.6-MeV incident neutron energy (E_n). Inelastic-scattering cross sections to levels and groups of levels to an excitation energy of 4.728 MeV were measured, and statistical model calculations were in good agreement below an E_n of 5.6 MeV with the measured values. The 2.085- and 2.654-MeV levels were predicted to within 20 per cent up to an E_n of 7.6 MeV but the calculated cross sections for the higher levels were greater by as much as a factor of 2.5 than those measured. On the basis of the agreement below 5.6 MeV, support was given to a previous suggestion of a triplet comprising the group of levels at 3.60-MeV excitation energy, with the spin of the third level having to be greater than zero for a good fit to the data to be achieved. The addition of distorted-wave Born approximation and statistical model results gave cross sections that were in good agreement with experiment for inelastic scattering to the 0.846-MeV level. The calculated contribution of direct interactions to the excitation of this level was equal to 21 per cent at 4.0-MeV incident neutron energy, rose linearly with energy to a value of 57 per cent at 6.6 MeV, and reached a value of 66 per cent at 7.6 MeV. (Disser. Abstr.)

10984 PROTON POLARIZATION IN THE ^{28}Si(d,p)^{29}Si REACTION. Maddox, William Eugene. Bloomington, Ind., Indiana Univ., 1968. 149p.

Thesis.

For some time there has been considerable interest in deuteron stripping reactions at medium energies. There are several theories today which are able to reproduce the observed differential cross sections, but fall short in fitting the measured proton polarizations. To provide data for these theories, the polarization of the protons in the ^{28}Si(d,p)^{29}Si reaction leading to the ground state, the 1.28-, the 2.03-, and the 3.62-MeV states of ^{29}Si were measured. The incident deuteron energy was 10.8 MeV and the angular range was from 30 to 147° in the lab. The differential cross sections for the same reactions and for the elastic scattering of deuterons from ^{28}Si were also measured at the same deuteron energy. A new solid-state detector scattering chamber/polarimeter assembly using carbon as an analyzer was used to make the measurements. This assembly allowed the proton polarization measurements on the four groups of this work to be made simultaneously. The data were analyzed using the Indiana University CDC 3600 computer. Gaussian distributions along with an exponential background were fitted to each raw spectrum to extract the total counts in each peak. The analyzing power of the polarimeter was calculated using the geometry of the system and published data for the cross sections and proton polarizations in the ^{12}C(p,p)^{12}C reaction. For $l_n = 0$ ground-state reaction, the observed polarizations change rapidly from large negative to large positive values near the 50 and 90° minima in the cross section. The proton polarizations for this state have been measured at other energies, and a comparison between the present work and those measurements shows good agreement in the region of overlap. The present work extends the measurements further back in angle. The observed polarizations for the 1.28-MeV state also oscillate between rather large positive and negative values. Measurements on this state have also been made at a different energy and there is good agreement between that measurement and the present work. Polarizations of protons corresponding to the 2.03- and 3.62-MeV excited states are observed to be smaller (between ±0.3). No previous measurements have been made on these states. The 1.28- and 2.03-MeV states have neutron angular momentum transfer given by $l_n = 2$ with $j_n = 3/2$ and $5/2$ respectively. DWBA analysis using central distortion only indicates that these two states should show proton polarizations of the same shape but slightly different magnitudes. The observed 16 shapes of the polarizations of these states are found to be similar and the polarization magnitude of the 1.28-MeV excited state is larger than that of the 2.03-MeV state. (Disser. Abstr.)

10985 QUASIELASTIC ELECTRON SCATTERING ON LIGHT NUCLEI WITH KNOCK-OUT OF NUCLEONS AND COMPLEX PARTICLES. I. Balashov, V. V.; Meboniya, D. V. (Moscow State Univ. Tbilisi State Univ., USSR). Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 3: 122-45(1968). (In Russian).

In connection with the first experiments on quasielastic scattering of high-energy electrons on nuclei, the possibilities of such reactions for studying the structure of light nuclei are analyzed. In particular, the advantages of the reactions of quasielastic electron scattering are studied in comparison with the well-known reactions (p,2p). (auth)

10986 STUDIES OF TWO-PARTIALLY VACANT STATES. Kasan'yu, Yu.; Kotton, E.; Mittig, V.; Papino, L.; Set, K. K.; Tsindro, N. (CEN, Saclay, France. Rudjer Boskovic Inst., Zagreb). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1650-2(1968). (In Russian).

Results are given of new measurements of excitation functions for proton scattering by ^{40}Ca leading to the following states in ^{40}Ca: 0^+ (ground state), 0^+ (3.35 MeV energy), 3^- (3.74 MeV) and 2^+ (3.90 MeV). Measurements were carried out at $\theta_{lab} = 90$, 125, 141, and 160°, with a resolving power close to 10 keV and incident proton energies 4.800 MeV $\leq E_p \leq$ 6.060 MeV. Graphical data are included for three inelastic reactions ^{40}Ca(p,p′) at $\theta_{lab} = 125°$, 0^+ (3.35 MeV), 2^+ (3.90) and 3^- (3.73) MeV. (R.V.J.)

10987 ON THE ^{83}Sr DECAY. Basina, A. S.; Kraft, O. E.; Lebedev, P. P.; Naumov, Yu. V.; Moskvin, L. N.; Vrzal, Ya.; Liptak, Ya.; Urbanets, Ya. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1633-9 (1968). (In Russian).

A decay scheme for ^{83}Sr was developed using previously published data. Measurements of γ spectra (at 40 to 2650 keV), internal conversion electrons, β spectra (starting at 350 keV), and $e^- - \gamma$ and $\beta^+ - \gamma$ coincidences of ^{83}Sr are tabulated and compared with published data. (R.V.J.)

10988 BETA SPECTRUM AND CONVERSION ELECTRON SPECTRUM OF ^{72}As. Vitman, V. D.; Dzhelepov, B. S.; Medvedev, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1625-8(1968). (In Russian).

The hard components of the β^+ spectra and the most intense conversion lines of ^{72}As were measured using a background-free double-focusing $\pi\sqrt{2}$ β spectrometer. The resolving power of the spectrometer was 0.22% at light intensity of nearly 0.1%. (R.V.J.)

10989 L-FORBIDDEN MAGNETIC DIPOLE TRANSITIONS AND MAGNETIC MOMENTS OF ODD SPHERICAL NUCLEI. Birbrair, B. L.; Erokhina, K. I.; Isakov, V. I.; Lemberg, I. Kh. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1618-24(1968). (In Russian).

Numerical calculations of l-forbidden M 1 transition probabilities and of magnetic moments of ground states were made for a large number of spherical nuclei using the method developed by B. L. Birbrair (Yadernaya Fizika, 2: 746(1967)). (R.V.J.)

10990 ANGULAR DISTRIBUTION ASYMMETRY OF POLARIZED DEUTERONS ELASTICALLY SCATTERED ON ^{32}S AND ^{58}Ni NUCLEI. Klimenko, A. S.; Kostin, V. Ya.; Mal'ko, A. I.; Saltykov, L. S.; Chirko, V. I. Ukr. Fiz. Zh., 13: 1731-3(Oct. 1968). (In Russian).

An expression is given for the elastic scattering cross section for polarized deuterons on nuclei with zero spin and with a sufficiently large mass. The expression contains the first scattering angle θ_1 and the second scattering angle θ_2. The angle between the planes of the first and second scatterings is denoted by ϕ. Two types of asymmetry were measured by determining the readings to the "left," "right," "up," and "down." Polarized 11.8-MeV deuterons scattered from C at $\phi_1 = 30°$ were scattered a second time in S targets having a thickness of 20 mg/cm^2 and in ^{58}Ni targets having a thickness of 18 mg/cm^2. After the second scattering the deuterons were detected in two mutually perpendicular planes. The maximum asymmetry at angles of 18, 24, 30, 36, and 42° for ^{58}Ni was approximately a factor of two less than for C and S. (TTT)

10991 MEAN REACTION CROSS-SECTIONS FOR REACTOR NEUTRONS FOR (n,p), (n,α), AND (n,2n) REACTIONS WITH ^{59}Co, ^{58}Ni, ^{54}Fe, AND ^{89}Y. Braun, H.; Nagy, L. (Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta, 10: 15-19(1968). (In German).

The nuclides ^{59}Co, ^{58}Ni, ^{54}Fe, and ^{89}Y were irradiated under Cd in the FR-2 reactor of Karlsruhe. After chemical separation of the activities originated through (n,p), (n,α), and (n,2n) reactions, the mean cross sections $\sigma_{reactor}$ were determined. The relations $\sigma_{reactor}/\bar{\sigma}_{fission}$ and $\Phi_{fast}/\Phi_{thermal}$ are specified for several irradiation channels in this reactor. (auth)

10992 THE CIRCULAR POLARIZATION OF γ RAYS AFTER CAPTURE OF POLARIZED THERMAL NEUTRONS IN NUCLEI.

Eichler, J. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys. 219: 114-23(1969). (In German).

A 70% polarized thermal neutron flux of 6×10^6 s^{-1} was obtained by total reflection of a 1-m-long Co–Fe mirror. Natural targets of Al, Co, Mo, and Sm were exposed to this beam. The measurement of the circular polarization of high-energy capture γ rays yielded some information about nuclear properties. For the transition from the compound state to the ground state in ^{28}Al the E2/M1 mixing ratio $\delta = -2.0$ was derived. In ^{96}Mo, the spin of the 2.25 MeV level was found to be $J^\pi = 2^-$ or 3^-. If in agreement with theory, the spin for this level is $J^\pi = 3^-$; the compound state for this decay has $J^\pi = 2^+$ for over 50% of the transitions. In accordance with a previous measurement the spins of the doublet in ^{60}Co at 0.278 and 0.288 MeV were $J^\pi = 3^+$ or 4^+. For ^{150}Sm the overall circular γ polarization was determined. The measurement is in agreement with the statistical nuclear model yielding for the compound state $J^\pi = 4^-$. The earlier spin assignment $J^\pi = 4^+$ for the 0.777-MeV level of ^{150}Sm was confirmed. (auth)

10993 GAMMA-RAY ENERGIES OF RADIONUCLIDES FORMED BY NEUTRON CAPTURE DETERMINED BY Ge(Li) SPECTROMETRY. Dams, R.; Adams, F. (Univ. of Ghent). Radiochim. Acta, 10: 1-11(1968).

Gamma-ray energies of radionuclides formed by neutron capture were determined by high-resolution Ge(Li) spectrometry. The most abundant gamma rays were determined with an accuracy of better than 0.2 keV in the energy region between 80 and 1400 keV. The energies of gamma transitions above 1400 keV may be less accurate. Atomic number and gamma energy sequence lists are included. These tables are intended to be helpful in the identification of isotopes in neutron activation analysis. (auth)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 9511, 9730, 10905, 10912, 10928, 10934, 10936, 10945, 10957–10959, 10961, 10965, 10968, 10969, 10980, 10989, 10992, 10993, 11041, 11055, 11059, and 11076.

10994 (CAR-882-23) MUON CAPTURE IN LEAD. Sashin, Donald; Nadelhaft, Irving (Carnegie-Mellon Univ., Pittsburgh, Pa.). Oct. 1968. Contract AT(30-1)-882. 92p. Dep. CFSTI.

Thesis.

The disappearance rate, decay rate and decay electron energy spectrum were measured for negative muons stopping in a thin lead sheet sandwiched between two optical spark chambers. A carbon reference target was used to eliminate the necessity of knowing the precise value of the detection efficiency of the apparatus, and the muon concentration of the beam of particles from the cyclotron. The decay electron energy spectrum was also found for muons stopping in the carbon target. Scanning the muon and electron tracks in the spark chambers enabled the elimination of most of the background of muons stopping in material other than the target. The decay electron energy was measured in a large sodium iodide crystal. The decay and disappearance rates for negative muons in lead were found to be .46 ± .03 (10^6/sec) and 13.1 ± .9 (10^6/sec) respectively. A theoretical spectrum previously calculated by Huff and corrected for experimental resolution was compared to the measured decay electron energy spectrum for negative muons in lead. A best value for $\rho = .72 \pm .05$ was obtained with a χ^2 of 23.8 compared to an expected χ^2 of 19 ± 6.2. In a similar way the data for negative muons stopping in carbon were analyzed to give a best value of $\rho = .72 \pm .06$ with a χ^2 of 15.6 compared to an expected χ^2 of 19 ± 6.2. (auth)

10995 (CEA-R-3530) SPECTROSCOPIC STUDY OF NEAR CLOSED-SHELL NUCLEI Z = 50, BY MEANS OF THE (^{3}He,d) AND (d,^{3}He) REACTIONS ON ALL EVEN TIN ISOTOPES AND THE (^{3}He,d) REACTION ON THE A = 113 AND A = 115 INDIUM ISOTOPES. Harar, Samuel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1968 143p. (In French). Dep.

Thesis. Submitted to Univ., Orsay, France.

A systematic study of (^{3}He,d) reactions at 18-MeV incident energy and (d,^{3}He) reactions at 22-MeV incident energy on ^{112,114,116,118,120,122,124}Sn was made. The distorted-wave Born approximation (DWBA) was used to extract information on the transferred angular momentum l_p, the change of parity, and the spectroscopic factor. The influence of the proton-neutron residual interaction on the spread of the pure proton configuration (particle or hole) and on the observed level sequence was investigated. Experimental results and predictions of the Kisslinger and Sorensen model are in reasonable agreement. A study of ^{113,115}In(^{3}He,d)^{114,116}Sn reactions shows strong experimental evidence that the proton particle-hole components are weak in the first excited states of tin nuclei. Furthermore, highly excited states (~4 to 6 MeV) having a simple structure with one predominant particle-hole configuration have been located. (auth)

10996 (COO-1716-6) THERMODYNAMIC STUDIES ON HEAVY ELEMENTS AND STUDIES IN NUCLEAR CHEMISTRY. Annual Report, February 1968–January 1969. Cobble, J. W. (ed.) (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). Jan. 1969. Contract AT(11-1)-1716. 15p. Dep. CFSTI.

Research progress is reported on: ternary fission of ^{238}U by ^{3}He ions, angular distribution of ^{28}Mg from ternary fission of ^{238}U with ^{4}He ions, ternary fission of ^{232}Th with 40-MeV ^{4}He ions, ternary fission in ^{197}Au and ^{209}Bi, search for ternary fission products in the spontaneous fission of ^{252}Cf, and thermochemical studies on heavy element and rare earth chlorides. (M.C.G.)

10997 (GA-8812) APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS. Project Summary Report, November 10, 1967–June 30, 1968. Beyster, J. R.; Bramblett, R. L.; Ginavin, R. O.; Gozani, T.; Jupiter, C. P.; Kull, L.; McMillan, J. I.; Rundquist, D. E. (Gulf General Atomic, Inc., San Diego, Calif.). July 29, 1968. Contract AT(04-3)-167. 48p. Dep. CFSTI.

Prompt and delayed neutron yields from photonuclear processes in ^{239}Pu, ^{235}U, and ^{238}U were measured. The decay of the neutron populations following irradiations of various lengths was also studied. Mass-yield curves and γ spectra of fission products were also investigated as possible nuclear signatures. The precision of assays based on an electron accelerator assay system was analyzed, as were attenuation effects in the irradiation of large samples. Computer programs were developed for calculating bremsstrahlung spectra and neutron yields from photofission. A scanner and detector system for bulk assays was fabricated, and an irradiation facility was constructed. (D.C.W.)

10998 (GA-8854) A SET OF EVALUATED NUCLEAR DATA FOR ^{233}U. Boroughs, G. L.; Craven, C. W. Jr.; Drake, M. K. (Gulf General Atomic, Inc., San Diego, Calif.). Aug. 27, 1968. Contract AT(04-3)-167. 65p. Dep. CFSTI.

A study was made of the neutron cross sections and associated nuclear data for ^{233}U. A set of data was prepared in the ENDF/B format and was sent to the Evaluation Center at Brookhaven National Laboratory. The data include resolved and unresolved resonance parameters for capture and fission at 0.0001 eV to 15 MeV; pointwise-in-energy elastic scattering cross sections from 0.0001 eV to 15 MeV; pointwise cross sections for the total and partial neutron cross sections from 100 keV to 15 MeV; angular distributions for elastically scattered neutrons; energy distributions for secondary neutrons from (n,n'), (n,2n), (n,3n), and (n,f) reactions; the number of neutrons produced per fission; and fission-product yields for thermal neutron fission. (D.C.W.)

10999 (JINR-P7-4205) ON SPONTANEOUS FISSION OF LEAD; SEARCH FOR VERY FAR TRANSURANIUM ELEMENTS. Flerov, G. N.; Perelygin, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 7p. (In Russian). Dep.

With the help of charged-particle detectors the tracks of the nuclear fission fragments in Pb and its compounds were detected. For lead glass, this effect corresponds to an apparent half-life of spontaneous fission of Pb equal to 2 to 3×10^{20} years. The effect observed may serve as an assumption about the existence of long-lived spontaneously fissioning transuranium nuclide. (auth)

11000 (NP-17722) PRECISION MEASUREMENTS IN THE DECAY OF ^{113}Sn. Fogelberg, B.; Baecklin, A. (Forskningradens Laboratorium, Studsvik (Sweden)). 1968. 7p. (LF-23). Dep.

Energies and intensities of γ-rays and conversion electrons following the decay of ^{113}Sn were measured with Ge(Li) diodes and a double-focusing β spectrometer, respectively. No trace of a 647-keV crossover transition was found. (auth) (Sweden)

11001 (ORNL-TM-2426) NUCLEAR STRUCTURE STUDIES IN THE MASS-90 REGION WITH THE (^{3}He,d) REACTION. Cates, Michael Reid (Oak Ridge National Lab., Tenn.). Jan. 1969. Contract W-7405-eng-26. 169p. Dep. CFSTI.

Thesis. Submitted to Texas Agricultural and Mechanical Univ., College Station.

The (^{3}He,d) reaction on target nuclei of ^{90}Zr, ^{91}Zr, ^{92}Zr, and ^{93}Nb was studied using 31-MeV ^{3}He ions from the Oak Ridge Isochronous Cyclotron. The deuteron groups corresponding to low-lying excited states in the residual nuclei, ^{91}Nb, ^{92}Nb, ^{93}Nb, and ^{94}Mo, were recorded in a broad-range magnetic spectrograph. Angular dis-

tributions for these states were compared with distorted-wave calculations to obtain angular momentum transfers and spectroscopic factors. The shell-model configurations of the protons in the nuclei studied were inferred from the spectroscopic information and model systematics. Shell-model wave functions, based on an assumed ^{88}Sr core and inferred two-body residual interactions among the extra-core nucleons, were tested by comparison with spectroscopic results. In particular, overlap integrals and predicted excitation energies were compared with spectroscopic factors and experimental excitation energies. Evidence for proton holes in the $2p_{\frac{1}{2}}$ orbital was shown for each target, and the distribution of protons among the $1f_{\frac{7}{2}}$, $2p_{\frac{3}{2}}$, $2p_{\frac{1}{2}}$, and $1g_{\frac{9}{2}}$ orbitals was inferred for each target. (auth)

11002 (TID-24876) STUDIES OF THE COLLECTIVE STATES IN ^{152}Gd, ^{152}Sm, AND ^{154}Gd. Riedinger, Leo Louis Jr. (Vanderbilt Univ., Nashville, Tenn.). Jan. 1969. 226p. Dep. CFSTI.

Collective excitations in ^{152}Gd, ^{154}Gd, ^{156}Gd, and ^{152}Sm were investigated by measuring γ singles and coincidence spectra from the decay of ^{152}Eu, ^{154}Eu, and ^{156}Eu; and the results were compared with the predictions of several macroscopic and microscopic collective models. Previously reported conversion-electron data were used to obtain conversion coefficients, log-ft values, and branching percentages. Transition probabilities were determined, and the experimental E0 matrix elements were used to estimate the change in radius between the 0^+ and 2^+ levels of the ground-state band. The properties of the ground-state rotational bands and the β- and γ-vibrational bands were studied in detail. Only preliminary results were obtained for the ^{156}Eu decay scheme. (D.C.W.)

11003 (UCRL-Trans-10306) THE DECAY OF ^{170}Lu. Bonch-Osmolovskaya, N. A.; Vrzal, Ya.; Grigor'ev, E. P.; Zaytseva, N. G.; Liptak, Ya.; Tishin, V. G.; Urbanets, Ya. Translated by F. D. Jones for Univ. of California Lawrence Radiation Lab., Livermore, from report JINR-P-6-3452. 36p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 1649. (TSS)

11004 (WAPD-TM-760) INTEGRAL MEASUREMENTS OF NEUTRON CAPTURE AND FISSION IN ^{233}U (LWBR DEVELOPMENT PROGRAM). Gunst, S. B.; Conway, D. E.; Harris, D. R. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Aug. 1968. Contract AT(11-1)-Gen-14. 24p. Dep. CFSTI.

Reviews of available data for ^{233}U show that the recommended 2200 m/sec values of parameters have not changed very much in recent years, but the uncertainties have decreased significantly. Nevertheless, the need for additional work at thermal energies is pointed out, especially for thermal capture and the thermal alpha, the capture-to-fission cross-section ratio. A review of ^{233}U epithermal integral measurements reported by seven groups of experimenters throughout the world gives a conditioned set in which the capture integral for the energy range from 0.5 eV to infinity is 137 ± 6 barns, the fission integral is 779 ± 25 barns, and the epithermal alpha is 0.176 ± 0.005. 40 references. (auth)

11005 LEVELS IN ^{143}Pr POPULATED IN THE DECAY OF ^{143}Ce. Gregory, P. R.; Schellenberg, L.; Sujkowski, Z.; Johns, M. W. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 46: 2797-2808(Dec. 15, 1968).

Experiments using Ge(Li) and NaI(Tl) detectors singly and in a 2-parameter coincidence arrangement were carried out to establish the role of a number of weak transitions in the decay of ^{143}Ce. Twenty-six of the twenty-seven observed γ rays were placed in a decay scheme with levels at 57.4, 350.6, 490.2, 721.8, 739.9, 847.9, 937.3, 1059.8, (1156.5), 1160.1, 1381.6, and 1397.4 keV. The K-conversion coefficients of the 293- and 350-keV transitions, measured with a Si(Li) detector, are 0.10 ± .02 and 0.024 ± 0.03, respectively. (auth) (Canada)

11006 NUCLEAR CHARGE DISPERSION IN THE FISSION OF ^{232}Th BY PROTONS OF ENERGY 20 TO 85 MeV. Benjamin, P. P.; Marsden, D. A.; Porile, N. T.; Yaffe, L. (McGill Univ., Montreal). Can. J. Chem., 47: 301-12(Jan. 15, 1969).

^{232}Th was irradiated with protons of energy 20 to 85 MeV and the independent yields of ^{130}Cs, ^{132}Cs, ^{134m}Cs, ^{134g}Cs, ^{136}Cs, ^{138}Cs, ^{86}Rb, and the cumulative yields of ^{137}Cs and ^{138}Xe were measured radiochemically. Charge dispersion curves were constructed at various energies and, as in previous studies, the broadening with increasing energy and shift of the most probable charge towards stability were observed. The most probable charge of a fission fragment of a given mass number lies closer to the line of β-stability in the case of thorium fission than in uranium. Detailed calculations in an attempt to correlate the experimental data with equal charge displacement (ecd) and unchanged charge displacement (ucd) charge distribution postulates were attempted. The results are not conclusive, lying in between the two, but favoring ucd at the higher energies. (auth) (Canada)

11007 14.8 MeV NEUTRON-INDUCED FISSION OF ^{233}U. Borden, Kenneth Duane. Fayetteville, Ark., Univ. of Arkansas, 1968. 92p.

Thesis.

Neutron-induced fission of ^{233}U was studied at an incident neutron energy of 14.8 MeV. The cumulative mass yields were measured by radiochemical techniques. Good agreement was noted between the data and yields reported by other investigators for neutron-induced fission ^{235}U at a similar neutron energy. When the above results are compared with those from thermal neutron fission of ^{233}U (2,3) the following changes were observed: a decrease in the peak-to-valley ratio, indicating a larger contribution of symmetric fission than is observed in thermal neutron fission; a broadening of the fragment peaks; and a splaying out of the sides of the fragment peaks. Fine structure as observed in the fission of the other uranium isotopes, ^{235}U (3) and ^{238}U (4), was not observed in this investigation in the mass region A = 131 to 135. Attempts were made to compute the fission yields by correcting for the distribution of fragments about the most probable charge. The most probable charges were calculated by three different methods. The method proposed by Pappas gave a better fit to the smooth curve drawn through neighboring points than did the methods proposed by Glendenin, Coryell and Edwards and Wolfsberg. Also it was suggested that the absence of fine structure in the region A = 131 to 135 was in agreement with the results from thermal neutron fission of ^{233}U and the interpretation of the results reported by Terrel. (Diss. Abstr.)

11008 DENSITY OF ORBITAL ELECTRONS OF ATOMS OF C, Si, AND Ge IN THE FIELD OF ORDERED NUCLEI. INTERPRETATION OF ISOMERIC SHIFT OF ^{119}Sn. Dautov, L. M.; Kaipov, D. K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, No. 2, 7-13(1968). (In Russian).

An analysis of the density of electrons of C, Ge, and Si in the field of ordered nuclei was made. The results were extrapolated to atoms of Sn, and an interpretation of the isomeric shift of ^{119}Sn was formulated. (tr-auth)

11009 ANGULAR ANISOTROPY OF FISSION OF NUCLEI LIGHTER THAN GOLD BY 40-MeV α PARTICLES. Kuvatov, K. G.; Okolovich, V. N.; Smirenkin, G. N. (Inst. of Nuclear Physics, Alma-Ata, USSR). JETP Lett., (USSR) (Engl. Transl.), 8: 171-3(Sept. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 8: 277-81(Sept. 20, 1968).

The angular distributions of fragments from the fission of ^{197}Au, ^{185}Re, and ^{187}Re by 40-MeV alpha particles were measured. The data confirm the presence of a maximum in the effective moment of inertia in accordance with predictions of the liquid-drop model. The position of the maximum agrees with a value of 45 ± 1 for the parameter Z^2/A. (J.W.R.)

11010 ANGULAR ANISOTROPY OF FRAGMENTS FROM TERNARY FISSION OF ^{235}U AND ^{238}U. Kovacs, Istvan; Nagy, Laszlo; Nagy, Tibor; Vinnay, Istvan. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 16: 325-30(1968). (In Hungarian).

Angular anisotropy measurements on fragments from ternary fission were made using semiconductor detectors. The incident neutron energies were 14 MeV for ^{238}U and 2.5 or 14 MeV for ^{235}U. For 14-MeV neutrons, the angular anisotropy was found to be higher than that observed in binary fission, while for 2.5-MeV neutrons it was similar to that observed in binary fission. (D.C.W.)

11011 FURTHER TEST OF M1 ADMIXTURES IN THE DECAY OF $2^{+\prime}$ BETA VIBRATIONAL STATES. Hamilton, J. H.; Ramayya, A. V.; Whitlock, L. C. (Vanderbilt Univ., Nashville). Phys. Rev. Lett., 22: 65-7(Jan. 13, 1969).

The γ-γ directional correlation of the 692-123 keV, $2^{+\prime} \rightarrow 2^+ \rightarrow 0^+$ cascade in ^{154}Gd was remeasured with an improved Ge(Li)-NaI system. The spectra in coincidence with the Compton background and the 123-keV photopeak were simultaneously recorded at each angle. The new results averaged with earlier work yield $A_2 = -0.141 \pm 0.022$ and $A_4 = 0.311 \pm 0.040$. These values are consistent only with the 692-keV transition being essentially pure E2. (auth)

11012 CORRELATION ANALYSIS OF THE SLOW-NEUTRON INDUCED FISSION CROSS SECTION OF ^{239}Pu. Patrick, B. H.; James, G. D. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Lett., 28B: 258-60(Dec. 9, 1968).

A correlation analysis, of the type suggested by Egelstaff, was made on the results of high-resolution measurement of the fission cross section of ^{239}Pu. Highly significant correlations are observed and interpreted as being due to fission occurring through

levels, with a spacing of 460 ± 80 eV, built on the second minimum in the fission potential as predicted by Strutinsky. (auth)

11013 NUCLEAR QUADRUPOLE MOMENT OF ^{209}Bi. Eisele, G.; Koniordos, I.; Mueller, G.; Winkler, R. (Technische Univ., Berlin). Phys. Lett., 28B: 256-7(Dec. 9, 1968). (In German).

By optical methods the hyperfine structure of the Bi-II levels 6p7s $^3P_1$ and $^1P_1$ was determined from which the nuclear quadrupole moment $Q(^{209}Bi) = -0.379 \pm 0.015$ b is evaluated. (auth)

11014 APPROXIMATE INTERNAL CONVERSION COEFFICIENTS FOR N, O AND P SHELL ELECTRONS. Dragoun, O. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Jahn, P.; Allers, H.; Vobecky, M.; Daniel, H. Phys. Lett., 28B: 251-2 (Dec. 9, 1968).

The N-subshell internal conversion coefficients of the 158-keV E2 transition in ^{199}Hg were measured and found to be in agreement with theoretical values corrected for screening by the ratio of screened and unscreened electron bound-state densities. (auth)

11015 ROLE OF THE NEUTRON IMAGINARY POTENTIAL IN THE (p,n) CHARGE EXCHANGE REACTION. Garvey, G. T.; Miller, P. S. (Princeton Univ., N. J.). Phys. Lett., 28B: 243-5 (Dec. 9, 1968).

The cross section for (p,n) charge exchange for $^{91}Zr(p,n)^{91}Nb^*$ is calculated near and above threshold in the distorted-wave Born approximation using a charge-independent formalism. The results are compared to experiment and are found to be especially sensitive to the imaginary potential for the outgoing neutron. The results are inconsistent with the vanishing of the imaginary potential in the channel with total isospin equal to $T_0 + \frac{1}{2}$. (T_0 is the isospin of the target.) (auth)

11016 INVESTIGATION OF NEUTRON–PROTON HOLE STATES IN ^{206}Tl BY THE REACTION $^{208}Pb(d,\alpha)^{206}Tl$. Lewis, M. B.; Daehnick, W. W. (Univ. of Pittsburgh). Phys. Rev. Lett., 22: 77-9(Jan. 13, 1969).

The neutron-hole, proton-hole states of ^{206}Tl were studied by the direct reaction $^{208}Pb(d,\alpha)^{206}Tl$ with 17-MeV deuterons. The experimental resolution of 15 keV or better permitted the detection of many two-hole states, most of them previously unknown. For most levels, L values could be extracted from the comparison of microscopic distorted-wave Born approximation (DWBA) calculations with experimental angular distributions. The experimental level energies and J^π assignments (or limits) are compared with recent calculations by Kuo and are found to be in good agreement. (auth)

11017 ELEMENTS BEYOND 100, PRESENT STATUS, AND FUTURE PROSPECTS. Seaborg, Glenn T. (Atomic Energy Commission, Washington, D. C.). Annu. Rev. Nucl. Sci., 18: 53-152(1968).

A review of recent research on the nuclear and chemical properties of the heaviest elements and on methods for producing these elements is presented, with emphasis on elements beyond Z = 100. Systematics for predicting the synthesis and properties of new elements and isotopes are discussed, as are production processes, future production facilities, and some applications of transuranium elements. Some recent work on lighter transuranium elements is also covered. 332 references. (D.C.W.)

11018 NEUTRON-DEFICIENT OSMIUM AND RHENIUM ISOTOPES. Hughes, C. A. (Liverpool Regional Coll. of Tech.). J. Inorg. Nucl. Chem., 31: 19-27(Jan. 1969).

The decay characteristics of ^{180}Os, ^{181}Os, ^{182}Os, ^{177}Re, ^{178}Re, and ^{179}Re, produced by spallation of rhenium with 340-MeV protons, are reported. The osmium isotopes ^{180}Os and ^{181}Os decay by electron capture with half-lives of 19.8 and 112.3 min, respectively. The ^{182}Os, half-life 22.6 hr, is associated with a positron group of 1.1 MeV. The ^{177}Re and ^{178}Re are both positron emitters (3.2 MeV and 1.95 MeV, respectively) of half-lives 28 and 50 min. Confirmation of ^{179}Re as a 19-min electron capture nuclide was obtained. Evidence for a 2- to 3-min Os isotope was also obtained, together with confirmation of the non-existence of 20-hr ^{180}Re. (auth) (UK)

11019 INVESTIGATION OF THE ^{214}Po γ-RAY SPECTRUM WITH A Ge(Li) PAIR SPECTROMETER. Lauppe, W.; Luehrs, G. (Univ., Mainz). Z. Phys., 219: 169-84(1969). (In German).

The γ-ray spectrum of ^{214}Po between energies of 1.1 and 3.3 MeV was measured with a resolution of 4 to 5 keV. The energies and intensities of 69 γ rays are tabulated, and an improved level scheme of the $^{214}Bi-^{214}Po$ decay is proposed. (auth)

11020 ENERGY LEVELS OF ZIRCONIUM ISOTOPES. Berman, B. L. (Univ. of California, Livermore); Baglan, R. J. J. Inorg. Nucl. Chem., 31: 9-17(Jan. 1969).

The energies of seven low-lying excited levels of ^{90}Zr, ^{91}Zr, and ^{92}Zr were measured to within a few tenths of a keV. A high-intensity bremsstrahlung beam from a linear accelerator was used to create the radioactive niobium nuclei ^{92}Nb, ^{91}Nb, and ^{90}Nb by the (γ,n), (γ,2n), and (γ,3n) reactions on ^{93}Nb. After the niobium nuclei decayed to the zirconium isotopes, ^{92}Zr, ^{91}Zr, and ^{90}Zr, the energies of the transition γ rays from these zirconium isotopes were measured with a high-resolution lithium-drifted germanium detector and were used to determine the energy levels of the zirconium isotopes. The energy levels determined in this way are, for ^{90}Zr, 2186.3, 2318.8, 3447.6, and 3590.4 keV; for ^{91}Zr, 1205.0 keV; and for ^{92}Zr, 934.3 and 1847.2 keV. (auth) (UK)

11021 L-SUBSHELL CONVERSION LINE INTENSITY RATIOS FOR PURE M1($1 \rightleftharpoons 0$) TRANSITIONS. Gelletly, W.; Geiger, J. S. (Chalk River Nuclear Labs., Ontario). Nucl. Phys., A123: 369-85 (1969).

The L-subshell conversion line intensity ratios of five pure M1 transitions were measured with the Chalk River iron-free, $\pi\sqrt{2}$ β-spectrometer at momentum resolutions ranging from ≈ 0.04% to 0.19%. The transition energies in keV and the L_I/L_{II} and L_I/L_{III} ratios for the cases studied are ^{144}Pr, 80.12, 12.2 ± 0.3, 59.6 ± 3.0; ^{144}Pr, 133.53, 13.4 ± 0.2, 64.3 ± 1.7; ^{166}Ho, 82.45, 11.4 ± 0.2, 72.3 ± 1.1; ^{210}Bi, 46.503, 9.67 ± 0.13, 115 ± 3; ^{212}Bi, 238.6, 9.36 ± 0.13, 133.5 ± 6. The results were compared with theoretical ratios deduced from the tabulations of Rose, Sliv and Band, Pauli, and Hager and Seltzer. These comparisons reveal significant discrepancies between the theoretical ratios of Rose and experiment for these M1 transitions. The theoretical ratios of Sliv and Band, Pauli, and Hager and Seltzer agree well among themselves and with experiment. The experimental ratios are found to be in best agreement with the theoretical ratios of Sliv and Band and of Pauli which take account of the contribution of the dynamic nuclear penetration effect to the internal conversion coefficient, but the experimental accuracies, which range from 2 to 4%, are not sufficient to allow an unqualified conclusion concerning the validity of this small correction. The L-subshell conversion ratios of the 59.03 keV, pure M3 ($3^- \rightarrow 0^-$) transition in ^{144}Pr were also measured and found to be $L_I/L_{II} = 6.43 \pm 0.32$ and $L_I/L_{III} = 0.662 \pm 0.008$. These ratios are in agreement with theory. (auth)

11022 ELECTROMAGNETIC PROPERTIES OF THE K = ½ ROTATIONAL BAND IN ^{169}Tm. Guenther, C.; Huebel, H.; Kluge, A.; Krien, K.; Toschinski, H. (Univ., Bonn). Nucl. Phys., A123: 386-400(1969).

The magnetic moments of the I = 5/2 and 7/2 states of the K = ½ ground state rotational band of ^{169}Tm were measured by perturbed γ–γ angular correlations. The E2/M1 mixing ratios for two transitions in this band were determined by conversion electron subshell ratio and γ–γ angular correlation measurements. The electromagnetic properties of the K = ½ band are discussed within the framework of the collective model. Several other E2/M1 mixing ratios of transitions in ^{169}Tm are derived from L-subshell conversion electron and γ–γ angular correlation measurements. (auth)

11023 DECAY OF ^{95}Tc ISOMERS TO LEVELS IN ^{95}Mo. Chilosi, G.; Eichler, E.; Aras, N. K. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A123: 327-36(1969).

The decay of the ^{95}Tc isomers was studied with Ge(Li) and NaI detectors. Gamma-ray energies (and intensities) observed from the 20-hr ground state decay were 605 (0.1), 765.82 (100), 947.8 (2) and 1074.1 (4) keV. The 60 d isomeric decay revealed 203.94 (100), 219.4 (0.1), 252.9 (1.1), 582.15 (55), 616.5 (2.4), 786.21 (15), 820.65 (8.0), 835.14 (45), 1039.3 (5.0), 1057.0 (0.02), 1222.5 (0.01), and 1620.2 (0.06) keV. A level scheme was constructed with states in ^{95}Mo at 203.94, 765.82, 786.15, 820.65, 947.8, 1039.1, 1057.0, 1074.0, 1222.5, 1553, and 1620.2 keV. (auth)

11024 NEW ISOMER OF ^{170}Ho: DECAY OF ^{170}Ho(42 sec) AND ^{170m}Ho(2.9 min). Schussler, F.; Pinston, J. A. (CEN, Grenoble, France). Nucl. Phys., A123: 348-56(1969). (In French).

The examination of the beta and gamma activity resulting from the ^{170}Er(n, p) reaction has shown the existence of a new 2.9-min ^{170}Ho isomer. A decay scheme is proposed for the 42-sec and 2.9-min ^{170}Ho states. An unreported 249-keV gamma transition is shown to belong to 4.4-min ^{167}Dy produced by the $^{170}Er(n, \alpha)$ reaction. (auth)

11025 QUANTITATIVE STUDIES OF NUCLEAR STRUCTURE THROUGH ISOBARIC ANALOGUE RESONANCES. Darmodjo, Soesanto. Austin, Tex., Univ. of Texas, 1968. 78p.

Thesis.

Experimental and theoretical investigations of isobaric analogue resonances in ^{209}Bi, ^{139}La, ^{89}Y, and ^{121}Sb were carried out to extract quantitative nuclear structure information. Proton elastic scattering experiments on ^{88}Sr and ^{120}Sn targets were done at energies from 4.7 to 8.5 MeV and from 7.0 to 10.0 MeV, respectively. Calculations of theoretical proton elastic scattering cross

sections were done based on the theory of isobaric analogue resonances given by Weidenmuller and Mahaux. The observed experimental cross sections were compared with the results from the theoretical calculations to get the spectroscopic factors of the isobaric analogue states. Similar calculations were done for proton elastic scattering on ^{208}Pb and ^{138}Ba using the experimental data obtained by Moore et al., and Brentano et al. Dependence on the spectroscopic factors on various optical model parameters was studied. It is shown that the spectroscopic factors are quite insensitive to the choice of the optical model parameters. (Disser. Abstr.)

11026 COULOMB EXCITATION STUDIES OF ^{104}Pd, ^{106,108}Cd, ^{182,184,186}W, ^{186,188,190,192}Os, AND ^{192,194,196,198}Pt. Milner, William Thomas. Knoxville, Tenn., Univ. of Tennessee, 1968. 207p. Thesis.

Coulomb excitation studies of even-even nuclei of Pd, Cd, W, Os, and Pt were carried out in order to test the predictions of the various nuclear models which are available. Comparisons are made to the "vibrational," "rotational," and "pairing-plus-quadrupole" model estimates. The Coulomb excitations of states in these nuclei were induced by bombardment with protons, ^{4}He ions, and ^{16}O ions in the energy range of 2 to 5, 3 to 11, and 42 to 49 MeV, respectively. Excited states were observed by detecting the deexcitation γ rays with NaI and Ge(Li) detectors in γ singles, γ-γ coincident, and ^{16}O-γ spectra. The first 2^+, second $2'^+$, and 4^+ states were observed for most nuclei. In the case of ^{182,184,186}W the 6^+ state was also observed. Values of the reduced nuclear matrix elements, B(E2) and B(M1), are extracted in a model-independent fashion and the results are tabulated. Results for ^{104}Pd and ^{106,108}Cd are compared to the simple "vibrational" and "rotational" model predictions but the agreement is found to be rather poor. Results for W, Os, and Pt are compared to the microscopic (pairing-plus-quadrupole) model calculations of K. Kumar and M. Baranger as well as to the simple "rotational" and "vibrational" model predictions. The agreement between the experimental results and the microscopic model predictions is generally good for the case of first 2^+ and 4^+ states, with the exception of B(E2, $0 \rightarrow 2$) for ^{192,194,196}Pt and B(E2, $4 \rightarrow 2$)/B(E2, $2 \rightarrow 0$) for ^{186}W and ^{194,196}Pt. In these cases the experimental values are significantly smaller than the calculated values. In the case of second 2^+ states, the agreement between experimental results and the microscopic model predictions is generally poor. The angular distributions of γ rays from the $2'^+ \rightarrow 2^+$ transition following direct E2 excitation of the second $2'^+$ state were obtained with an accuracy sufficient to establish the sign and magnitude of the mixing ratio $\delta = (E2/M1)^{\frac{1}{2}}$. Computer programs used in the decomposition of γ-ray spectra and data reduction are described and Fortran listings are presented. (Disser. Abstr.)

11027 MOESSBAUER EFFECT STUDIES FOLLOWING COULOMB EXCITATION OF ^{162}Dy, ^{164}Dy, AND ^{238}U. Oleson, James Robert. Baltimore, Johns Hopkins Univ., 1968. 104p. Thesis.

The Moessbauer effect following Coulomb excitation of the first 2^+ states by ^{162}Dy, ^{164}Dy, and ^{238}U was studied. In experiments with a metallic uranium target and U_3O_8 absorber, poorly resolved hyperfine structure which was temperature dependent was observed. The structure is thought to arise from electric quadrupole splitting in the target and absorber, but quantitative interpretation of the structure is not possible. The maximum resonant absorption in the spectra was 1.7%. Observation of resonant absorption itself is significant and shows that the Coulomb excitation technique may be used for Moessbauer studies in an actinide. The hyperfine structure of ^{162}Dy and ^{164}Dy in a split by $DyFe_2$ absorber was obtained by using an unsplit target of ^{162}Dy Sb and ^{164}Dy Sb, resp. The fact that the DySb is effectively unsplit was verified in separate experiments using a radioactive source of ^{161}Tb which decays to ^{161}Dy. The resonant absorption of the unsplit 2 KeV gamma from $^{161}Dy_2O_3$ at room temperature in a DySb absorber at 13°K consisted of a single line with full width at half maximum of 2.45 cm/sec. The hyperfine structure of ^{162}Dy and ^{164}Dy were analyzed assuming electric field gradients having axial symmetry about the direction of the internal magnetic field. Using observed splittings of ^{161}Dy in $DyFe_2$ and a value of $g^{161} = -0.189 \pm 0.005$, the rotational gyromagnetic ratios were found to be $g_R^{162} = 0.364 \pm 0.023$; $g_R^{164} = 0.346 \pm 0.021$. In addition, the ratios of the intrinsic electric quadrupole moments of these nuclei to that of ^{161}Dy were found to be $Q^{162}/Q^{161} = 1.07 \pm 0.16$, $Q^{164}/Q^{161} = 0.93 \pm 0.12$. This is one of the few instances in which excited state moments have been measured by the angular correlation of radiation, by the Moessbauer effect with a radioactive source, by the Moessbauer effect following an (n,γ) reaction, and by the Moessbauer effect following Coulomb excitation. The moments determined by these methods all agree within experimental error. The gyromagnetic ratios are about 10% greater than the Nilsson and Prior theoretical estimates. (Disser. Abstr.)

11028 STUDY OF THE NUCLEAR ENERGY LEVELS ASSOCIATED WITH THE DECAY OF ^{172}Lu AND ^{168}Tm. Prather, James Gordon Jr. Logan, Utah, Utah State Univ., 1968. 170p. Thesis.

An internal-conversion electron spectrometer was constructed employing a Si(Li) detector and FET preamplifier mounted inside a cryogenic housing. The dependence of the energy resolution of electrons and photons upon the operating temperature and bias voltage of the Si(Li) detector was studied for a number of detectors. An energy resolution of 1.6 keV (FWHM) for 100-keV electrons and of 2.3 keV for 1-MeV electrons was obtained with an 80 mm^2 by 2 mm Si(Li) detector operated at 220°K and at 200 V bias. Efficiency calibrations of the internal-conversion electron spectrometer and of a gamma-ray spectrometer employing a 2.5 cm^2 by 8 mm Ge(Li) detector and a cryogenic FET preamplifier were made. The decay of ^{172}Lu to excited states in ^{172}Yb and the decay of ^{168}Tm to excited states in ^{168}Er were studied with the Si(Li) spectrometer, the Ge(Li) spectrometer, and a Ge(Li)-NaI(Tl) gamma-ray multiparameter coincidence spectrometer. The proposed level scheme for ^{172}Yb is composed of 23 excited states. Of the 97 transitions observed in the gamma-ray spectrum, 77 were also observed in the internal-conversion electron spectrum; and K-conversion coefficients were obtained for these transitions. A K = 0 ground state rotational band ($I^\pi = 0^+, 2^+, 4^+$, and 6^+), a K = 3 rotational band ($I^\pi = 3^+, 4^+, 5^+$, and 6^+) based on the 1172.3-keV [3^+] state, a K = 2 rotational band ($I^\pi = 2^+, 3^+$, and 4^+) based on the 1465.9-keV [2^+] state, a K = 3 rotational band ($I^\pi = 3^+, 4^+$, and 5^+) based on the 1662.8-keV [3^+] state, a K = 4 rotational band ($I^\pi = 4^+$ and 5^+) based on the 2073.1-keV [4^+] state and a K = 3 rotational ($I^\pi = 3^+$ and 4^+) based on the 2174.9-keV [3^+] state were proposed. The results of this study were consistent with the existence of a K = 3 rotational band ($I^\pi = 3^+, 4^+$, and 5^+) based on the 1700.6-keV [3^+] state. These states were formerly interpreted as members of a K = 2 rotational band based on a 1608.9-keV [2^+] state not observed to be populated in the present work. The K = 2 band based on the 1465.9-keV [2^+] state is interpreted to be, at least predominantly, a γ-vibrational band. Arguments were made for the two-quasiparticle configuration assignments of the remaining single-particle states. The proposed level scheme for ^{168}Er is composed of 11 excited states. Of the 33 transitions observed in the gamma-ray spectrum, 24 were also observed in the internal-conversion electron spectrum; and K-conversion coefficients were obtained for these transitions. A K = 0 ground-state rotational band ($I^\pi = 0^+, 2^+$, and 4^+) a K = 2 rotational band ($I^\pi = 2^+, 3^+, 4^+$ and 5^+) based on the 821.1-keV [2^+] state, a K = 4 rotational band ($I^\pi = 4^-$ and 5^-) based on the 1093.9-keV [4^-] state and a K = 3 rotational band ($I^\pi = 3^-$ and 4^-) based on the 1541.3-keV [3^-] state were proposed. The K = 2 band based on the 821.1-keV [2^+] state is interpreted to be a γ-vibrational band. Arguments were made for the two-quasiparticle configuration assignments of the 1093.9-keV [4^-] and 1541.3-keV [3^-] states. (Disser. Abstr.)

11029 NEW ISOTOPE ^{136}Nd AND ITS DECAY PRODUCTS. Zhelev, Zh.; Kalinnikov, V. G.; Liptak, Ya.; Peker, L. K. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1610-17(1968). (In Russian).

The discovery of ^{137}Nd with half-life $T_{\frac{1}{2}} = 55.0 \pm 1.5$ min was announced previously by K. Gromov et al. (Nucl. Phys., 73: 65 (1965)). It is shown that the 55-min β^+ and γ activities are related to the decay of the new isotope ^{136}Nd and the daughter nucleus ^{136}Pr and not to the ^{137}Nd isotope. (R.V.J.)

11030 STUDIES OF γ-RAY SPECTRA OF (n,γ) REACTIONS ON SEPARATED ISOTOPES RECORDED BY Ge(Li) SPECTROMETER. Groshev, L. V.; Dvoretskii, V. N.; Demidov, A. M. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1630-2(1968). (In Russian).

Gamma spectra of thermal neutron (n,γ) reactions on Ba and Nd isotopes were measured. The thermal neutron beam was produced with optimum background conditions in the IRT-M reactor. (R.V.J.)

11031 POSITRONS IN ^{174}Lu DECAY. Klyuchnikov, A. A.; Mitrokhovich, N. F.; Feoktistov, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1640-3(1968). (In Russian).

A weak β^+ spectrum was observed in the decay of ^{174}Lu. The ^{174}Lu was obtained by bombardment of Yb with 13.6-MeV deuterons. Measurements carried out 6 months after the irradiation showed that the source contained only ^{173}Lu and ^{174}Lu. Gamma spectra for ^{173}Lu and ^{174}Lu are presented, together with a Fermi plot for ^{174}Lu. A decay scheme is proposed for ^{174}Lu. (R.V.J.)

11032 PROPERTIES OF SPONTANEOUSLY FISSIONING ISOMERIC ^{246}Cf. Gangrskii, Yu. P.; Markov, B. N.; Polikanov, S. M.; Kharisov, I. F.; Yungklaussen, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1644-9(1968). (In Russian).

The isomer cross-section ratio was measured for the production of ^{246}Cf in ^{12}C reactions on ^{238}U at 60 to 80 MeV. The distribution of fission fragments along vitreous detectors indicate an isomer lifetime of less than 10^{-7} sec. Alpha activity (E_α = 6.75 MeV and $T_{\frac{1}{2}}$ = 36 hr) of the ground state of ^{246}Cf was detected. (R.V.J.)

11033 INTERPRETATION OF THE TRANSITIONS IN ^{223}Ra OBSERVED BY INTERNAL CONVERSION. Briancon, Chantal; Vieu, Charles (CNRS, Orsay, France). Compt. Rend., Ser. A and B, 267: 651-3(Sept. 30, 1968). (In French).

The results of the measurement of the internal conversion with respect to the α decay of ^{227}Th are given: energies, absolute transition intensities, multipolarities, and an interpretation of the level scheme. (tr-auth)

11034 TWO-PARTICLE, ONE-HOLE STATES IN ^{209}Pb. Flynn, E. R. (Los Alamos Scientific Lab., N. Mex.); Igo, G.; Barnes, P. D.; Kovar, D. Phys. Rev. Lett., 22: 142-5(Jan. 27, 1969).

The reactions ^{207}Pb(t,p)^{209}Pb and ^{210}Pb(p,d)^{209}Pb were used to study the two-particle, one-hole states of ^{209}Pb. The complementary nature of these two reactions permits identification of all but three of the observed levels below 3561 keV. (auth)

11035 ANGULAR CORRELATION STUDY ON THE 223-161 keV CASCADE IN ^{133}Cs. Rao, P. Brahmananda; Lakshminarayana, V. (Andhra Univ., Waltair, India). Curr. Sci. (India), 38: 37(Jan. 20, 1969).

Angular correlation studies were carried out on the 223-161 keV γ-γ cascade in ^{133}Cs using the sum-peak coincidence technique. Spectra recorded at angles of 90, 135, and 180° between the detectors were used to fit the angular distribution to the standard polynomial and to obtain the correlation coefficients. The results support a spin assignment of $\frac{3}{2}$ for the 384-keV state. (D.C.W.)

11036 THE DECAY OF ^{147}Nd. Hill, John C.; Wiedenbeck, M. L. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A98: 599-613(1967). (COO-1112-86).

Precision energy measurements on 8 γ rays in the ^{147}Nd → ^{147}Pm decay were made with a 2m curved-crystal spectrometer. Energies of the 6 other γ rays were determined with a Ge(Li) spectrometer. The relative intensities of all γ rays were determined. A level scheme is proposed for ^{147}Pm which includes a new level at 680.4 keV. Evidence is given to support the exclusion of several levels reported by earlier investigators. Results are compared with predictions of intermediate coupling theory. (auth)

11037 APPLICABILITY OF THE STATISTICAL MODEL FOR EXPLAINING THE RATIO OF THE (n,n') TO (n,2n) CROSS SECTIONS. Petoe, G. (Inst. for Experimental Physics, Debrecen, Hungary); Bornemisza-Pauspertl, P.; Karolyi, J. Acta Phys. Acad. Sci. Hung., 25: 91-7(1968).

The cross sections for the reactions ^{205}Tl(n,2n)^{204}Tl, ^{204}Hg(n,2n)^{203}Hg, ^{204}Pb(n,2n)^{203m}Pb, ^{89}Y(n,n')^{89m}Y, ^{91}Zr(n,2n) + ^{90}Zr(n,n')^{90m}Zr, ^{197}Au(n,n')^{197m}Au, and ^{208}Pb(n,2n) + ^{207}Pb(n,n')^{207m}Pb were measured at a neutron energy of 15 ± 0.3 MeV. The results are 1680 ± 210, 2230 ± 300, 860 ± 180, 594 ± 130, 820 ± 200, 280 ± 64, and 1340 ± 174 mb, respectively. The cross-section ratios of (n,n') to (n,2n) reactions are considerably higher than the values predicted by the statistical model. Features of (n,2n) reactions are in agreement with evaporation mechanism, so the most probable explanation of these disagreements is the deviation of the actual spectrum from the evaporation spectrum supposed in the calculations. According to the present results, the competition of inelastic scattering can be important in the case of the heaviest elements too, so the Weisskopf assumptions are not applicable for nuclei with relatively low neutron excess. For the interpretation of the N-Z dependence of (n,2n) reactions, it is necessary to investigate the mechanism of the competing (n,n') processes. (auth)

11038 INCOHERENT SCATTERING OF GAMMA RAYS IN ZIRCONIUM. Rao, P. V. Ramana; Rama Rao, J.; Parthasarachi, K. (Andhra Univ., Waltair, India). Curr. Sci. (India), 37: 693 (Dec. 20, 1968).

Total gamma-ray cross sections in Zr were measured at 84, 100, 129, and 145 keV, and the bound electron scattering cross sections were derived by subtracting theoretical photoelectric and coherent scattering cross sections. The ratios of these cross sections to the free-electron scattering cross sections, as a measure of the effect of electron binding on the incoherent scattering, are compared with these predicted by the Thomas-Fermi model of Brown. It is seen that the model underestimates the effect of electron binding. (D.L.C.)

11039 MEAN REACTOR CROSS SECTIONS FOR THE (n,p) REACTION ON ^{140}Ce. Deschuyter, M.; Massart, D. L.; Speecke, A.; Hoste, J. (Univ. of Ghent). Radiochim. Acta, 10: 11-14 (1968).

The mean reactor cross section for the (n,p) reaction on ^{140}Ce was determined. An average value of 3.5 ± 0.9 μbarn was found. Procedures for the purification of Ce with respect to La and for the determination of less than 50 ppb quantities of La in Ce are described. (auth)

11040 DECAY OF CADMIUM AND INDIUM ISOTOPES 118 AND 119. Schwarzbach, E.; Muenzel, H. (Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta, 10: 20-6(1968). (In German).

^{118}Cd produced by U(d_{50}, f) was separated radiochemically and mass-spectrometrically from other fission products. A study of its decay showed that it is a pure β^- emitter decaying with a half-life of 50.3 min to the ground state of ^{118}In. Its 5-sec daughter was extracted continuously by means of a separating stirrer and also examined. It decays by β^- emission with 80% directly to the ground state of stable ^{118}Sn, and with 20% to at least three excited states of ^{118}Sn. The latter emit γ's of 525, 1225, 1680, and 1880 keV. The metastable isomer of ^{118}In could not be found in the decay of ^{118}Cd. It was produced by ^{118}Sn(n,p)^{118}In. The study of its decay yielded a new half-life of 4.4 ± 0.1 min and a modified decay scheme. The nuclides ^{119}Cd and ^{119}In in their ground states and metastable states were isolated from fission products. An examination showed that their decay is very complex and only partly known at present. Half-lives, γ energies, and γ intensities were redetermined giving some new results. (auth)

Nuclear Theory

Refer also to abstracts 9794, 10905, 10928, 10936–10939, 10972–10975, 10978, 10985, 11001, 11002, 11009, 11015, and 11037.

11041 (AAEC/TM-467) A NOTE ON THE ENERGY DEPENDENCE OF THE RADIATIVE STRENGTH FUNCTION. Musgrove, A. R. de L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sept. 1968. 9p. Dep.

The simple Blatt and Weisskopf estimate for radiative width is used with an improved formula for the density of levels near the ground state (Gilbert and Cameron 1965) to calculate the energy dependence of the radiative width and the radiative strength function. It is found that the radiative width decreases while the radiative strength function exhibits a slow increase with increasing neutron bombarding energy. (auth)

11042 (AECL-3182) SU_3 CLEBSCH-GORDAN COEFFICIENTS IN THE 2S-1D SHELL NUCLEI. Sebe, T. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Sept. 1968. 29p. (CRNL-189). Dep. CFSTI. CAN $1.00.

In a recent article a general expression was derived for the SU_3 Clebsch-Gordan coefficients based on the group chain $SU_3 \supset R_3$. The present paper provides an Apex program for its numerical calculation. The basis states used here have been mutually orthogonalized and are closely related to the non-orthogonal states of Elliott. The formula giving normalization coefficients was improved in order to obtain these coefficients for any SU_3 representations without referring to their symmetry properties between $(\lambda\mu)$ and $(\mu\lambda)$. Explanations concerning many Apex subroutines, useful in writing shell-model programs, are also given. (auth)

11043 (ANU-P-382) NUCLEAR REACTION THEORIES: LECTURES BY A. M. LANE. Clark, G. J.; Kerr, G. W. (Australian National Univ., Canberra. Research School of Physical Sciences). Apr. 6, 1967. 185p. Dep.

A series of lectures dealing with nuclear reaction theories are presented. S-matrix, R-matrix, and various modified-Hamiltonian theories are discussed in detail. 45 references. (J.W.R.)

11044 (BARC-350) ON THE USE OF MODELS IN NUCLEAR STRUCTURE. Ramanna, R. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 36p. Dep. CFSTI.

Instead of considering the process of nuclear fission as resulting only from the deformations of a charged liquid drop, the process is studied as the consequence of a stochastic exchange of nucleons between the two sides of a dividing nucleus. The stochastic exchange can be justified on quantum mechanical grounds. The transition probabilities are evaluated from purely ground-state data. In this way it is possible to determine the mass and charge of the fragments, which are in good agreement with the experiments with only a second order dependence on deformation. Some experiments pertaining to these measurements are discussed.

In order to study the ground-state properties of nuclei, use is made of the fact that a set of Schroedinger equations can be put into differential forms defined on a Riemann surface or manifold. It is shown that the choice of the manifold and its connectivity determines the ground-state nuclear properties such as n–p ratios, Coulomb and binding energies, and shell structure. The minimization of the energy is done through Dirichlet's principle. In this way the problem of determining specific two-body forces is transferred to determining the geometry of the Riemann manifold which, in the nuclear case, turns out to be a surface of genus 1, i.e., a torus. (auth)

11045 (BNL–12965) NEUTRON RESONANCE CAPTURE γ RAYS. Chrien, R. E. (Brookhaven National Lab., Upton, N. Y.). Oct. 1968. 31p. (CONF-681024–1). Dep. CFSTI.

From Symposium on Low-Energy Nuclear Physics, Albany, N. Y.

The information that γ spectroscopy provides concerning the capturing and final states in the neutron capture process is discussed following a summary of the features of the capture process and the various types of capture experiments. (D.C.W.)

11046 (BNL–tr–233) SPECTRUM OF VIBRATIONAL AND ROTATIONAL EXCITATIONS OF A FOUR-PARTICLE SYSTEM. Filippov, G. F. (Akademiya Nauk Ukrainskoi SSR, [Kiev]. Institut Teoreticheskoi Fiziki). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from a Preprint. 22p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 39690.

11047 (CEA–R–3404) HARTREE–FOCK THEORY FOR THE EQUILIBRIUM SHAPE OF LIGHT NUCLEI. Ripka, Georges (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sept. 1968. 180p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Faculte des Sciences, Orsay, France.

The Hartree-Fock equations are derived. The expansions of the orbits and the possible symmetries of the Hartree-Fock field are discussed. Wave functions of even-even N = Z nuclei are given for $12 \leq A \leq 40$. The role of the monopole, quadrupole, and exchange components of the force are discussed. The multiplicity of the solutions and the effect of the spin-orbit interaction are discussed. Exact angular momentum projection is used to generate rotational bands. The validity of the adiabatic rotational model in light nuclei is discussed. Hartree-Fock calculations are extended to include major-shell mixing in order to obtain quadrupole deformations without the use of effective charge. The incompressbility of nuclei is discussed; and the compatibility between the Hartree-Fock solutions, the Mottelson model of quadrupole deformations, and the SU3 states of J. P. Elliott and M. Moshinsky is established. (auth)

11048 (ITEF–625) PHENOMENOLOGICAL THEORY OF ANALOGUE RESONANCES. Shapiro, I. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1968. 24p. (In Russian). Dep.

It is shown that the resonance rescattering in the initial and final channels gives rise to the fine structure of analogue resonances. By means of an approximation to the unitary condition, formulas are derived which describe the energy behavior of the cross section and the connection between partial and total widths. The results obtained are valid in the region of non-overlapping levels of the compound nucleus. (auth)

11049 (JINR–P4–4144) ON A POSSIBLE FACTORIZATION OF TWO-PARTICLE T-MATRIX IN THE THREE-BODY PROBLEM. Belyaev, V. B.; Wrzecionko, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 18p. (In Russian). Dep.

A simple and clear method of factorization of the local potential is proposed. For smooth potentials of the Yukawa type the procedure is quite simple and gives a good approximation of the local potential. For the Yukawa potential the two-particle T-matrix was calculated and its off-energy shell behavior was investigated. A sharp discrepancy in the behavior of the Yamaguchi T-matrix and the calculated T-matrix was established. (auth)

11050 (KHVL–102) ON THE ENERGY SPECTRUM IN 3-BODY NUCLEAR REACTIONS. Cao-Xuan-Chuan (Saigon Univ. (South Vietnam). Dept. of Physics). [nd]. 8p. Dep.

The extent of deformation in the shape of the energy spectrum calculated from pure phase-space considerations is examined. A single final-state interaction between two of the three outgoing particles is assumed. The analysis shows that this spectrum depends strongly on kinematical factors when the recoil is not neglected. (auth)

11051 (MIT–2098–495) OVERLAPPING POTENTIALS AND MULTIPLE SCATTERING THEORY. Feshbach, Herman (Massachusetts Inst. of Tech., Cambridge). Oct. 1968. Contract AT(30-1)-2098. 17p. Dep. CFSTI.

A formulation of multiple scattering theory is proposed which makes use of the impact parameter approximation and the expansion of the phase shift function in one, two and many body operators. Explicit results are given for the case in which the expansion is truncated after two terms, retaining the one and two body terms. Evaluation is obtained by appropriate use of the semiclassical physical optical approximation. It is used to show that the effect of the overlap in the incident nucleon-target nucleon potentials can be important for the determination of correlations in the target nuclear wave function by elastic scattering. The use of experiments which are more sensitive to correlation effects is thus recommended. (auth)

11052 (UCRL–18270) TABLES OF STRUCTURE AMPLITUDES FOR (α,d) REACTIONS. Glendenning, Norman K. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1968. Contract W-7405-eng-48. 72p. Dep. CFSTI.

Tables of structure amplitudes for (α,d) reactions, useful in the analysis of two-nucleon transfer reactions, are given. (J.W.R.)

11053 HEXADECAPOLE DEFORMATION IN THE NUCLEAR 2s–1d SHELL. Turner, R. J.; Trainor, L. E. H. (Univ. of Toronto). Can. J. Phys., 46: 2749–52(Dec. 15, 1968).

It is shown that the $5/2^+$ spins of the ground states in ^{25}Al and ^{25}Mg are evidence for hexadecapole contributions to the Nilsson model for the self-consistent field. (auth) (Canada)

11054 EXISTENCE OF ISOBARIC SPIN AND ITS USEFULNESS IN NUCLEAR SPECTROSCOPY AND IN THE STUDY OF NUCLEAR STRUCTURE. Wiktor, Stefan (Inst. for Nuclear Research, Krakow). Postepy Fiz., 19: 539–55(1968). (In Polish).

The concept of isobaric spin as a certain mode of nuclear freedom resulting from the charge independence of nuclear forces is described. The meaning of isobaric spin is illustrated within the framework of the shell model of the nucleus, and the prescription is given for classifying nuclear states in terms of it. Recent studies of analogue states and analogue resonances observed in nuclear reactions are then reviewed. The practical usefulness of the study of analogue resonances in nuclear spectroscopy as well as the knowledge of Coulomb energy in investigations of nuclear structure are discussed. (auth)

11055 ISOBARIC SPLITTING OF 1^- LEVELS IN NUCLEI. Bergeron, J. (Univ., Laval, Quebec); Goulard, B.; Venter, R. H. Can. J. Phys., 46: 2771–8(Dec. 15, 1968).

Isospin fragmentation of the dipole excitations of nuclei with neutron excess is discussed. Simple expressions are derived for the energy splitting and for the sharing of dipole strength between the two isospin components. The effect of relaxing some assumptions is investigated. The case of ^{90}Zr is taken as an illustration. (auth) (CANADA)

11056 LOCAL PHENOMENOLOGICAL NUCLEON–NUCLEON POTENTIALS. Reid, Roderick V. Jr. (Massachusetts Inst. of Tech., Cambridge. Cornell Univ., Ithaca, N. Y.). Ann. Phys. (N.Y.), 50: 411–48(1968).

Hard (infinitely hard) and soft (Yukawa) core potentials were fit to Yale and Livermore phase parameters and low-energy data. The potentials are local and static except that a different one is used for each state of distinct isotopic spin, total spin, and total angular momentum. It is found that neither the short-range behavior of the potentials nor the central-to-tensor ratio in the $^3S_1$–$^3D_1$ state is well determined by the data. Present data do exclude potentials containing only local central, tensor, and spin–orbit terms. Addition of a quadratic spin–orbit potential such as that used by the Yale group or by Hamada and Johnston helps greatly but is probably not enough to completely reproduce the data. Nevertheless, present-day theories which use potentials are not likely to be sensitive to failures due to use of this form. (auth)

11057 THEORY OF EXCITED STATES OF DEFORMED EVEN–EVEN NUCLEI. Karaev, R.; Sharipov, Sh. Izv. Vyssh. Ucheb. Zaved., Fiz., No. 9, 7–12(1968). (In Russian).

The excited states of nonspherical nuclei were investigated. The change of nuclear shape with excitation was calculated. (tr-auth)

11058 IMPORTANCE OF THE SHELL EFFECT IN THE (n,2n) REACTION CROSS SECTION. Adam, Andras; Jeki, Laszlo. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 16: 331–6(1968). (In Hungarian).

It is shown that if the shell effect of the threshold energy for reaction is taken into account, the (n,2n) reaction cross section can be described by a phenomenological equation which is a function of the symmetry parameter N−Z/A only. The predicted cross section values are in good agreement with the experimental data, indicating that the shell effect of the level density parameter and the effect of the pairing energy do not appear in the value of the (n,2n) cross section within the systematic error of the measurement. (auth)

11059 SEMIEMPIRICAL FORMULA FOR THE ENERGY LEVELS OF EVEN-EVEN NUCLEI. Varshni, Y. P. (Univ. of Ottawa). Progr. Theor. Phys. (Kyoto), 40: 1181-2(Nov. 1968).

A semiempirical formula for the energy levels of even−even nuclei is proposed which gives a good fit to experimental values, including those for very highly neutron-deficient nuclei. (J.W.R.)

11060 REMARKS ON THE AVERAGE CROSS SECTIONS USING THE UNITARY POLE RESONANCE FORM OF THE COLLISION MATRIX. Ullah, N. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett., 28B: 240-2(Dec. 9, 1968).

A simple prescription is given to find the conditions imposed by unitarity on the resonance parameters of the pole resonance form of the collision matrix. Explicit relations are written down for the case of two channels and an arbitrary number of interfering compound nuclear resonances. These relations are used to show that the average cross section, obtained with the unitary form, will always be less than or equal to the one given by the random correlation approximation. It is shown that, independent of the number of channels and the value of the ratio of the average width to the average spacing, the mean square deviation of the partial total cross section is exactly equal to the fluctuation of the partial elastic cross section multiplied by the factor $2\pi/k_c^2$, where k_c is the wave number in channel c. (auth)

11061 NARROW RESONANCES FROM UNBOUND STATES. Delsanto, P. P. (Univ., Frankfurt am Main. Univ., Cagliari, Italy); Roetter, M. F.; Wahsweiler, H. G. Phys. Lett., 28B: 246-8(Dec. 9, 1968).

It is shown that there can occur in nucleon scattering cross sections a type of narrow resonance not due to bound states, which is caused by a $\frac{1}{2}\pi$ potential scattering phase shift in an inelastic channel. (auth)

11062 CONDITION FOR THE PRODUCTION OF POLARIZATION IN NUCLEAR REACTIONS. Harney, H. L. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett., 28B: 249-50(Dec. 9, 1968).

For spin $\frac{1}{2}$ particles produced in a nuclear reaction with unpolarized beam and target, the polarization (in general the odd rank polarization tensors) will be zero, if the reaction proceeds via one exit channel only. This result restricts the production of polarization in non-elastic resonance reactions. (auth)

11063 HIGH-ISOSPIN NUCLEI AND MULTIPLETS IN THE LIGHT ELEMENTS. Cerny, Joseph (Univ. of California, Berkeley). Annu. Rev. Nucl. Sci., 18: 27-52(1968). (UCRL-18106).

The experimental data on high-isospin states and isobaric multiplets are reviewed. Progress made in establishing the limits of stability toward nucleon emission in the light elements is outlined. Mass predictions for unknown neutron-deficient isotopes are listed. 129 references. (J.W.R.)

11064 ON ANGULAR MOMENTUM PROJECTION FROM THE HARTREE-FOCK SOLUTION. Gupta, K. K. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys., A123: 477-80 (1969).

A Hartree−Fock calculation for the exactly solvable Q·Q force acting on particles in N = 2, 3 shells is carried out, and the angular momentum projected wave functions for N = 2 shell are compared with the exact solutions. For an attractive force, the agreement between the two is very good, whereas for a repulsive force no HF solution exists. (auth)

11065 MAGNETIC DIPOLE MOMENTS OF EXCITED NUCLEAR STATES. Grodzins, L. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Annu. Rev. Nucl. Sci., 18: 291-342(1968).

A review is presented of methods used for the measurement of magnetic moments of excited states of nuclei. 247 references. (J.W.R.)

11066 INTRINSIC DEFORMATIONS OF COLLECTIVE 0^+ STATES. Kleber, Manfred (Technische Hochschule, Munich); Schmidt, Hartwig. Z. Phys., 219: 162-8(1969).

It is shown that 0^+ pairing vibrations are associated with rather large mean square values of the quadrupole moment, indicating a pronounced intrinsic deformation. This deformation is demonstrated using a two-level model, where the pairing vibration can be treated analytically within the quasiboson approximation. The results are compared with the data for the 6.06-MeV state in ^{16}O. (auth)

11067 TWO-BODY INTERACTION CURRENTS AND NUCLEAR MAGNETIC MOMENTS. Chemtob, Marc (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys., A123: 449-70 (1969).

The meson-theoretical approach to nuclear interaction currents is considered in the one-meson exchange approximation. Results are presented for two models of charge-symmetric πN coupling: the γ_5 model and the static model. The effect of interaction currents on the nuclear dipole magnetic moment of odd-mass nuclei with jj closed-shells plus (or minus) one nucleon is calculated within the framework of the pure spherical shell model. For nuclei with a closed ls core (^{15}N, ^{17}O, ^{39}K, and ^{41}Ca), first-order perturbation corrections are also taken into account. The contribution of interaction magnetic moments is found to be generally small in magnitude, but to depend strongly on the angular momentum of the nucleus; the net effect is a translation of both Schmidt lines, upwards for odd-proton nuclei and downwards for odd-neutron nuclei. For ^{209}Bi, the correction is 0.5 nuclear magneton. The magnetic moment associated with the two-body spin-orbit interaction is also calculated: it accounts for approximately $\frac{1}{5}$ of the contribution from the one-body spin-orbit force. (auth)

11068 MEASUREMENT OF SHORT NUCLEAR LIFETIMES. Schwarzschild, A. Z.; Warburton, E. K. (Brookhaven National Lab., Upton, N. Y.). Annu. Rev. Nucl. Sci., 18: 265-90(1968).

A review is presented of the methods used for the measurement of short nuclear lifetimes. Advantages and disadvantages of the delayed-coincidence, microwave, recoil-distance, and Doppler-shift attenuation methods are discussed. 86 references. (J.W.R.)

11069 COMPOUND NUCLEAR REACTIONS INDUCED BY HEAVY IONS. Thomas, T. Darrah (Princeton Univ., N. J.). Annu. Rev. Nucl. Sci., 18: 343-406(1968).

Heavy ion-induced reactions in which compound-nucleus formation and statistical decay play a major role are discussed. Those aspects of the statistical model that are particularly evident in heavy-ion reactions are emphasized. (D.C.W.)

11070 SHELL-MODEL THEORY OF THE NUCLEUS. Mang, H. J. (Technische Hochschule, Munich); Weidenmueller, H. A. Annu. Rev. Nucl. Sci., 18: 1-26(1968).

The generalization of phenomenological shell-model theory is discussed. A general single-particle model that contains the shell model as a special case and partly takes into account the effective residual interaction is constructed, and the description of collective excitations is discussed with emphasis on the treatment of the residual interaction. The application of the shell model to nuclear reactions is also described. 143 references. (D.C.W.)

11071 COULOMB-ENERGY RADII FROM ISOBARIC MASS PARABOLAS. Durnford, A. M. I. A. W. (Univ. of Western Ontario, London). J. Phys. A (London), 2: 59-65(Jan. 1969).

The mass difference for mirror nuclides is expressed in terms of the curvature $2C_2$ of the corresponding isobaric mass parabola and the (fractional) "atomic number" Z^* corresponding to its minimum. With the Coulomb energy of a nucleus taken as $\gamma_A Z(Z-1)/A^{\frac{1}{3}}$, it is shown that $C_2(A-2Z^*) = \beta + \gamma_A(A^{\frac{1}{3}} - A^{-\frac{1}{3}})$, where β represents the hydrogen−neutron mass difference. The relation is valid for both odd and even values of A. The availability of empirical values of C_2 and Z^* permits the evaluation of γ_A and thence the "Coulomb-energy radius" $R_c = r_A A^{\frac{1}{3}}$ where $r_A \equiv \frac{3}{5}e^2/\gamma_A$. Consideration of a "quantal" formula for the Coulomb energy of a nucleus shows that the "quantal" values of r_A are slightly smaller than the "classical" values, but the difference becomes negligible for large values of A. Although there are significant variations in r_A, the general trend is to smaller values of r_A as A gets larger, e.g., $r_A = 1.47$ fm for $16 \le A \le 74$ whereas $r_A = 1.30$ fm for $120 \le A \le 198$. Values of r_A corresponding to almost all values of A from 16 to 249 are given graphically, and estimates of the error are included. (auth) (UK)

11072 LOCALIZATION OF NUCLEAR REACTIONS AND THE INVESTIGATION OF THE NUCLEAR SURFACE. Jackson, Daphne F. (Univ. of Surrey, Guildford, Eng.). Nucl. Phys., A123: 273-99(1969).

A range of processes available for the study of the surface region of nuclei is discussed, and an attempt is made to determine which are most sensitive to the extreme surface region and to the difference between the proton and neutron distributions. The processes discussed are α-particle scattering, kaon absorption,

knock-out reactions with protons and α-particles, high-energy proton scattering, and pion production. (auth)

11073 TREATMENT OF TWO INTERACTING PARTICLES IN A POTENTIAL WITH THE LIPPMANN–SCHWINGER EQUATION. Gloeckle, W.; Heiss, W. D. (Institut fuer Theoretische Physik, Heidelberg). Nucl. Phys., A123: 305-26(1969).

The various processes of two interacting particles in a potential are studied. A unique solution of the Lippmann–Schwinger equation is given by constructing the resolvent of its kernel. This resolvent contains an energy-dependent interaction which can be calculated by solving a Hilbert–Schmidt integral equation. Exact expressions are obtained for the various reaction amplitudes. Their structure and their approximative treatment are discussed. (auth)

11074 SHELL-MODEL CALCULATIONS OF M1 TRANSITION PROBABILITIES FROM ISOBARIC ANALOGUE STATES. Maripuu, S. (Univ. of Utrecht). Nucl. Phys., A123: 357-64(1969).

Shell-model calculations of M1 transition probabilities within isobaric-spin doublets were performed for cases without configuration mixing. The Schmidt values and effective values of gyromagnetic ratios were used. A strong enhancement of M1 transition rates for the "parallel" case $J = j = l + \frac{1}{2}$ as compared to the "anti-parallel" case $J = j = l - \frac{1}{2}$ is obtained. It is also shown that the M1 transition probability in a certain single particle orbit is decreasing with increasing isobaric spin. The results are compared with recent experimental data. The positions of $\frac{7}{2}^-$ states in ^{31}P were calculated with the modified surface delta interaction for simple three-particle configurations. The wave functions thus obtained were used to calculate M1 transition probabilities between the $\frac{7}{2}^-$ states in ^{31}P. (auth)

11075 MODEL OF SPHERICAL NUCLEI FOR FISSION WITH LIGHT PARTICLE EMISSION. Doan, Thu Phong; Carles, Claude; Chastel, Raymond (Faculte des Sciences, Bordeaux). Compt. Rend., Ser. A and B, 267: 981-4(Oct. 28, 1968). (In French).

By considering the model of aligned spheres, the kinetic energy of the light particles emitted during fission was predicted. It was also shown that the center of the light particle is displaced toward the light fragment to the extent that the ratio of the masses of the two large fragments increases. (tr-auth)

11076 BARRIER PENETRABILITIES AND REDUCED WIDTHS FOR α DECAY IN THE MEDIUM-HEAVY REGION. Boedy, Z. (Inst. of Experimental Physics, Debrecen, Hungary); Rupp, E. Acta Phys. Acad. Sci. Hung., 25: 41-55(1968).

Alpha-decay barrier penetrabilities and reduced widths were calculated using all experimental disintegration energies and half-lives available in the medium–heavy region. Some problems arising in numerical work are discussed, and an extrapolation formula for penetrability vs energy is given. The agreement between the relative values of the "experimental" as well as theoretical reduced widths was found to be reasonable. (auth)

11077 POLARIZATIONS AND ASYMMETRIES IN STRIPPING REACTIONS. Tanifuji, Makoto; Yazaki, Koichi (Hosei Univ., Tokyo, Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 40: 1023-45(Nov. 1968).

Spin dependences of interactions appearing in the DWBA stripping amplitude were theoretically investigated by the invariant-amplitude method for polarizations of emitted protons from unpolarized targets, $P(\theta)$, and cross-section asymmetries from polarized targets, $A(\theta)$. In the case treated, the nuclear spins were $\frac{1}{2}$ and zero for the target and residual nuclei, the neutron being captured into an s-state. The theory gives a definite value of $P(\theta)/A(\theta)$ for each spin dependence without any numerical calculation. In particular, the conventional proton-spin-orbit assumption leads to $P(\theta)/A(\theta) = -3$, which is incompatible with the experimental data for the $^3He(d,p)^4He$ reactions. Possibilities of explaining the data are discussed. (auth)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstracts 10192, 11155, and 11254.

11078 (AEC-tr-6975) NUCLEAR POWER STATION BN-350. Leipunskii, A. I.; Afrikantov, I. I.; Orlov, V. V.; (and others) ([Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut]). Translated from a Russian report. 32p. Dep. CFSTI.

A complete description of the BN-350 reactor is given. Operations parameters are tabulated; operation, reload, and emergency modes are discussed. The containment and pressure vessels are described; source design parameters are given. Fuel and control elements and core configuration are described. Safety problems are discussed. Brief descriptions of the experimental work carried out in the BN-350 are listed. 7 references. (M.L.S.)

11079 (AI-AEC-Memo-12714) HNPF STEAM-SODIUM REACTION TESTS. Poucher, F. W. (Atomics International, Canoga Park, Calif.). June 21, 1968. 50p. Dep. CFSTI.

Two series of development tests were performed using steam-nitrogen gas mixtures to react various quantities of sodium. In the first test Na thicknesses of 0.5 and 2 in., and fixed steam volume percentages of 10 to 80%, were used. The tests demonstrated the feasibility of the steam $-N_2$ gas mixture method for reacting Na and served as the basis for establishing a preliminary procedure for reacting the residual sodium in the HNPF Reactor Vessel. The second test was performed to evaluate the preliminary procedure established in the previous tests. A Na thickness of 0.5 in. and steam volume percentages varying from 20 to 80% were used in a simulated HNPF system. No unusual conditions were encountered and the Na was completely reacted when the test was terminated after 59.5 hr. of operation. (auth)

11080 (CONF-680419-, pp 9-24) INCENTIVES FOR DEVELOPMENT OF FAST BREEDER REACTOR POWER PLANTS. Beekman, Myron C. (Detroit Edison Co., Mich.).

The growth rate of the electric power industry to the year 2000 is predicted. The economic competition between nuclear power and coal is analyzed. The economics of fast breeder reactor development are described. (D.C.C.)

11081 (CONF-680419-, pp 27-40) BREEDER REACTORS FOR DESALTING. Hammond, R. Philip; Burwell, C. C. (Oak Ridge National Lab., Tenn.).

In choosing an energy source for desalting seawater, the economic criterion is solely that the cost of a thousand pounds of low pressure steam shall be as low as possible. A method is shown for comparing widely differing steam sources on an equitable basis, and this method is applied to four types of advanced breeder reactors. A new concept using unclad metal fuel in a sodium coolant is shown as promising the lowest energy costs of the reactor types studied so far. 5 references. (auth)

11082 (DLCS-5000368) SHIPPINGPORT ATOMIC POWER STATION THIRD QUARTERLY OPERATING REPORT, 1968. (Duquesne Light Co., Shippingport, Pa. Power Stations Dept.). Contract AT(11-1)-292. 22p. Dep. CFSTI.

Topics discussed include: power operation; coolant conditions and status; refueling program; maintenance; and test program. (D.C.C.)

11083 (DOCKET-50130-1) PATHFINDER ATOMIC POWER PLANT. APPLICATION FOR AMENDMENT OF LICENSE DPR-11, AMENDMENT 27, ATTACHMENT 2. Safety Instrumentation Review and Resulting Modifications. (Northern States Power Co., Minneapolis, Minn.). Feb. 12, 1965. 180p. Dep. CFSTI.

A description of the safety review for Pathfinder (Sioux Falls Power Reactor) is given. Modifications made in process and nuclear safety instrumentation and in control rod drive circuits are detailed. The safety philosophy is outlined; safety systems are described. (M.L.S.)

11084 (DOCKET-50231-24) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Facility Description and Safety Analysis Report, Amendment 35, Suppl. 21. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Dec. 11, 1968. 50p. Dep. CFSTI.

Performance of the SEFOR fuel is analyzed for steady state and transient operation. Fuel failure detection methods and systems are described. Protection against criticality accidents during startup and shutdown is discussed. Fission product source terms used in accident calculations and operational considerations are defined. Operation of the spent fuel storage tank is discussed. (M.L.S.)

11085 (DOCKET-50244-9) [ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1]. (FORMERLY BROOKWOOD NUCLEAR STATION, UNIT NO. 1). Introduction and Genral Summary; Description of Site and Environment. Preliminary Facility Description and Safety Analysis Report, Vol. 1, Exhibit D. (Rochester Gas and Electric Corp., N. Y.). Nov. 2, 1965. 82p. Dep. CFSTI.

Information on the Robert Emmet Ginna Power Reactor, Unit 1 (formerly Brookwood) is given on: Introduction and General Summary and Site and Environment. (M.L.S.)

11086 (DOCKET-50244-10) [ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1]. (FORMERLY BROOKWOOD NUCLEAR STATION, UNIT NO. 1). Introduction and Genral Summary; Description of Site and Environment. Preliminary Facility Description and Safety Analysis Report, Vol. 1, Exhibit D, App. (Rochester Gas and Electric Corp., N. Y.). Nov. 2, 1965. 229p. Dep. CFSTI.

Data tabulations are given on the meteorology, seismology, geology, hydrology, and soil mechanics for the site of the Robert E. Ginna Power Reactor, Unit 1. (M.L.S.)

11087 (DOCKET-50244-11) [ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1]. (FORMERLY BROOKWOOD NUCLEAR STATION, UNIT NO. 1). Plant Design Description and Safety Analysis. Preliminary Facility Description and Safety Analysis Report, Vol. 2, Exhibit D, Part A. (Rochester Gas and Electric Corp., N. Y.). Nov. 2, 1965. 189p. Dep. CFSTI.

Information on Robert E. Ginna Power Reactor, Unit 1 is given on the following broad topics: Reactor; Reactor Coolant System; and Containment System. (M.L.S.)

11088 (DOCKET-50244-12) [ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1]. (FORMERLY BROOKWOOD NUCLEAR STATION, UNIT NO. 1). Plant Design Description and Safety Analysis. Preliminary Facility Description and Safety Analysis Report, Vol. 2, Exhibit D, Part B. (Rochester Gas and Electric Corp., N. Y.). Nov. 2, 1965. 158p. Dep. CFSTI.

Information on Robert E. Ginna Power Reactor, Unit 1 on the following broad topics: Engineered Safeguards; Plant Instrumentation and Control; Electrical Systems; Auxiliary and Emergency Systems; Steam and Power Conversion System; Radioactive Wastes and Radiation Protection; Safety Evaluation; and Training Program. (M.L.S.)

11089 (DOCKET-50244-13) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Final Facility Description and Safety Analysis Report, Amendment 13, Suppl. 7, Exhibit D-11. (Rochester Gas and Electric Corp., N. Y.). Dec. 20, 1968. 85p. Dep. CFSTI.

A detailed evaluation of blowdown effects on the integrity of the core and internals for the Robert E. Ginna Power Reactor, Unit 1 is given. Effects on the reactor vessel of the loss of coolant and the safety injection are analyzed. Stress data are tabulated. Revised pages for the final facility description and safety analysis report (FSAR) are included. (M.L.S.)

11090 (DOCKET-50250-2) TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND NO. 4. Introduction and Summary; Description of Site and Environment. Preliminary Safety Analysis Report, Vol. 1. (Florida Power and Light Co.). Mar. 28, 1966. 188p. (DOCKET-50251-2). Dep. CFSTI.

Information on Turkey Point Power Reactor, Units 3 and 4, is given on: Summary Description and Site and Environment. (M.L.S.)

11091 (DOCKET-50250-3) TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND NO. 4. Plant Design Description and Safety Analysis. Preliminary Safety Analysis Report, Vol. 2. (Florida Power and Light Co.). Mar. 28, 1966. 234p. (DOCKET-50251-3). Dep. CFSTI.

Information on Turkey Point Power Reactor, Units 3 and 4, is given on the following broad topics: Reactor; Reactor Coolant System; and Engineered Safeguards. (M.L.S.)

11092 (DOCKET-50250-4) TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND NO. 4. Plant Design Description and Safety Analysis. Preliminary Safety Analysis Report, Vol. 3.

(Florida Power and Light Co.). Mar. 28, 1966. 243p. (DOCKET-50251-11). Dep. CFSTI.

Information on the Turkey Point Power Reactor, Units 3 and 4, is given on the following broad topics: Plant Instrumentation and Control; Reactor Auxiliary Systems; Electrical Systems; Steam and Power Conversion Systems; Radioactive Wastes and Radiation Protection; Safety Evaluation; and Training Program. Appendices include: experience with high power level fuel rods and method of analysis and assumptions for core slump. (M.L.S.)

11093 (DOCKET-50250-5) TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND NO. 4. Preliminary Safety Analysis Report, [Amendment 1], Suppl. 1. (Florida Power and Light Co.). May 10, 1966. 72p. (DOCKET-50251-4). Dep. CFSTI.

Design, construction and inspection criteria are given for the prestressed concrete containment building for the Turkey Point Power Reactor, Units 3 and 4. Oceanography data and calculations regarding the flushing of Biscayne Bay are presented. (M.L.S.)

11094 (DOCKET-50250-6) TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND NO. 4. Preliminary Safety Analysis Report, [Amendment 2], Suppl. 2. (Florida Power and Light Co.). Aug. 15, 1966. 176p. (DOCKET-50251-5). Dep. CFSTI.

Coolant loss accident effects are evaluated for the Turkey Point Power Reactor, Units 3 and 4 for various size pipe breaks. Reactor shutdown and decay heat removal in the event of boiler tube rupture are discussed. The possibility and effects of a control room fire are considered. Integrity of engineered safeguards is evaluated; performance capability of the containment air recirculation system under accident conditions is analysed. The use of sea water for post accident heat removal is discussed; design criteria for the system are given. Design of the containment isolation system is detailed; containment piping penetrations and valving are tabulated. Emergency power systems design criteria are given. Flood protection and effects of hurricanes on water levels are discussed. A site meteorological analysis is given; meteorological parameters are specified. The control rod indicating and rod-drop detection systems are described. Design, fabrication, and inspection of the reactor vessel are discussed. Shared systems and components are tabulated. (M.L.S.)

11095 (DOCKET-50250-7) TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND NO. 4. Preliminary Safety Analysis Report, [Amendment 3], Suppl. 3. (Florida Power and Light Co.). Sept. 1, 1966. 164p. (DOCKET-50251-6). Dep. CFSTI.

Design data and criteria for the containment vessel liner for the Turkey Point Power Reactor, Units 3 and 4, are detailed. Details on the structural design of the prestressed concrete containment structure are given; complete stress analyses, loadings, and responses under thermal conditions are included. Specifications, procedures, and tests used for design and fabrication of concrete components are listed; quality control procedures are described. Steels used in the tendons and liner are specified. Containment proof testing procedures are discussed. Protection of the containment from both internally and externally generated missiles is analysed. (M.L.S.)

11096 (DOCKET-50250-8) [TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND NO. 4]. [Preliminary Safety Analysis Report, [Amendment 4], Suppl. 4. (Florida Power and Light Co.). Sept. 6, 1966. 33p. (DOCKET-50251-7). Dep. CFSTI.

Containment system pressure transients are analysed in detail; transient effects are considered. Efficiency of Emergency Core Cooling Systems (ECCS) are evaluated; data are shown graphically. Coolant loss accidents are analysed with and without ECCS operation. (M.L.S.)

11097 (DOCKET-50250-10) [TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND NO. 4]. [Preliminary Safety Analysis Report], [Amendment 7], Suppl. 7. (Florida Power and Light Co.). Oct. 13, 1966. 13p. (DOCKET-50251-9). Dep. CFSTI.

Data on accumulator system effects during coolant loss accidents are shown graphically. (M.L.S.)

11098 (DOCKET-50250-11) [TURKEY POINT NUCLEAR GENERATING UNITS NO. 3 AND NO. 4]. [Preliminary Safety Analysis Report], [Amendment 8], Suppl. 8. (Florida Power and Light Co.). Nov. 4, 1966. 165p. (DOCKET-50251-10). Dep. CFSTI.

In-service surveillance of the containment structure tendons is outlined; containment building proof testing is described. Piping penetrations and containment design are discussed; piping penetrations are listed. Design of the liner for the containment structure is considered; construction materials are listed. General descriptions of turbine units are given; an evaluation of turbine overspeed and failure is included. Appendices include: specifications for splicing of the reinforcing bar using the Cadweld process; design criteria and hurricane flood protection; stress-strain tests of prestressing tendons; heat transfer model for containment spray; and Emergency Core Cooling Systems performance evaluations. (M.L.S.)

11099 (DOCKET-50263-18) MONTICELLO NUCLEAR GENERATING PLANT, [MONTICELLO, MINNESOTA], UNIT NO. 1. [Facility Description and Safety Analysis Report], Amendment 11. (Northern States Power Co., Minneapolis, Minn.). Dec. 9, 1968. 105p. Dep. CFSTI.

The complete proposed Technical Specifications for the Monticello Power Reactor, Unit 1, are given. (M.L.S.)

11100 (DOCKET-50271-10) [VERMONT YANKEE NUCLEAR POWER STATION, VERNON, VERMONT]. [Plant Design and Analysis Report], Amendment 7. (Vermont Yankee Nuclear Power Corp., Rutland). June 2, 1967. 2p. Dep. CFSTI.

Information concerning the operation of the mechanical vacuum pump during control-rod-drop-accident conditions is presented. (D.C.C.)

11101 (DOCKET-50286-10) INDIAN POINT NUCLEAR GENERATING UNIT NO. 3. Preliminary Safety Analysis Report, Amendment 7, Suppl. 7, Exhibit B-7. (Consolidated Edison Co. of New York, Inc., New York). Dec. 9, 1966. 160p. Dep. CFSTI.

Flood conditions for the site of the Indian Point Power Reactor, Unit 3 are determined. The use of charcoal filters for decontamination of containment atmospheres under post-accident conditions is evaluated; data are tabulated and shown graphically. The containment air recirculation cooling and filtration system is detailed. Redundancy of radiation monitoring systems is discussed. (M.L.S.)

11102 (DOCKET-50286-11) INDIAN POINT NUCLEAR GENERATING UNIT NO. 3. Preliminary Safety Analysis Report, Amendment 8, Suppl. 8, Exhibit B-8. (Consolidated Edison Co. of New York, Inc., New York). Dec. 9, 1968. 17p. Dep. CFSTI.

An index to the questions on the Preliminary Safety Analysis Report (PSAR) for Indian Point Power Reactor, Unit 3, is given. Questions are correlated to PSAR sections. (M.L.S.)

11103 (DOCKET-50286-12) INDIAN POINT NUCLEAR GENERATING UNIT NO. 3. Preliminary Safety Analysis Report, Amendment 10, Suppl. 9, Exhibit B-9. (Consolidated Edison Co. of New York, Inc., New York). Jan. 3, 1969. 32p. Dep. CFSTI.

The research and development program for charcoal filters for the Indian Point Power Reactor, Unit 3 containment system is described. The performance of the charcoal filters in removal of radioactive methyliodide from containment atmospheres is evaluated. (M.L.S.)

11104 (DOCKET-50286-13) INDIAN POINT NUCLEAR GENERATING UNIT NO. 3. [Preliminary Safety Analysis Report], Amendment 9, Exhibit A-1. (Consolidated Edison Co. of New York, Inc., New York). Jan. 3, 1969. 5p. Dep. CFSTI.

Financial data on Consolidated Edison Company of New York, Inc., owners of Indian Point Power Reactor, Unit 3, are given. (M.L.S.)

11105 (DOCKET-50317-8) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 5. (Baltimore Gas Electric Co., Md.). Dec. 19, 1968. 153p. (DOCKET-50318-8). Dep. CFSTI.

Containment vessel liner design for the Calvert Cliffs Power Reactor, Units 1 and 2, is discussed; liner anchorage design calculations are given; details of the liner at the base slab-cylinder wall junction are shown. Effects of stress loading conditions on the containment structure are evaluated; data are tabulated. Emergency Core Cooling Systems (ECCS) are discussed; typical ECCS pump performance data are tabulated. Liquid effluent from the site is discussed; fission product discharge is tabulated as a function of isotope. Loss of coolant flow accident analyses are detailed. The rod ejection accident is analyzed; parameters and results are tabulated. Core parameters for a steam line break accident are given; margin requirements for the largest valve in the steam line are discussed. Revised and supplementary pages are included. (M.L.S.)

11106 (DOCKET-50331-7) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Amendment 1. (Iowa

Electric Light and Power Co., Cedar Rapids). Dec. 24, 1968. 204p. Dep. CFSTI.

Revised information on the Duane Arnold Power Reactor is given on the following topics: Introduction and Summary; Site; Containment; Engineered Safeguards; Instrumentation and Control; Radiation Protection and Radioactive Waste Handling; Auxiliary and Emergency Systems; and Safety Analysis. A complete evaluation of plant compliance with AEC General Design Criteria is included. (M.L.S.)

11107 (DOCKET-50333-1) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Vol. 1. (Power Authority of the State of New York). Dec. 31, 1968. 564p. Dep. CFSTI.

Information on the James A. Fitzpatrick Power Reactor is given under the following broad topics: Introduction and Summary; Site; Reactor; and Reactor Coolant System. (M.L.S.)

11108 (DOCKET-50333-2) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Vol. 2. (Power Authority of the State of New York). Dec. 31, 1969. 585p. Dep. CFSTI.

Information on the James A. Fitzpatrick Power Reactor is given on the following broad topics: Containment Systems; Engineered Safeguards; Control and Information; and Electrical Systems. (M.L.S.)

11109 (DOCKET-50333-3) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Vol. 3. (Power Authority of the State of New York). Dec. 31, 1968. 599p. Dep. CFSTI.

Information on James A. Fitzpatrick Power Reactor is given under the following broad topics: Auxiliary and Emergency Systems; Steam and Power Conversion System; Radiological Controls; Conduct of Operations; Initial Tests and Operations; and Safety Analysis. Appendices include: control rod drive system description and analysis, site environmental studies, core cooling test program, core thermal design, and the quality assurance program. (M.L.S.)

11110 (DOCKET-50334-1) BEAVER VALLEY POWER STATION. Preliminary Safety Analysis Report, Vol. 1. (Duquesne Light Co., Pittsburgh, Pa.). Jan. 15, 1969. 587p. Dep. CFSTI.

Information on the Beaver Valley Power Reactor is given under the following broad topics: Introduction and Summary; Site including a summary of WINDIF output, geological considerations, seismicity analysis, and soils investigations; and reactor. (M.L.S.)

11111 (DOCKET-50334-2) BEAVER VALLEY POWER STATION. Preliminary Safety Analysis Report, Vol. 2. (Duquesne Light Co., Pittsburgh, Pa.). Jan. 15, 1969. 591p. Dep. CFSTI.

Information on Beaver Valley Power Reactor is given on the following broad topics: Reactor Coolant System; Containment; Engineered Safety Features; Instrumentation and Control; and Electrical Systems. (M.L.S.)

11112 (DOCKET-50334-3) BEAVER VALLEY POWER STATION. Preliminary Safety Analysis Report, Vol. 3. (Duquesne Light Co., Pittsburgh, Pa.). Jan. 15, 1969. 573p. Dep. CFSTI.

Information on Beaver Valley Power Reactor is given on the following broad topics: Auxiliary and Emergency Systems; Steam and Power Conversion Systems; Radioactive Waste and Radiation Protection; Conduct of Operations; Initial Tests and Operations; and Safety Analyses. Appendices give the quality assurance program and seismic design criteria. (M.L.S.)

11113 (EUR-4079) LINGEN NUCLEAR POWER PLANT ANNUAL REPORT, 1967. (Kernkraftwerk Lingen G.m.b.H. (West Germany)). Nov. 1968. 34p. (In German). Dep.

Status of the construction of the Lingen Power Reactor is given Fuel element shipment schedules are given. The complete schedules for construction, licensing, and startup are given. Financing details are tabulated. (M.L.S.)

11114 (EUR-4091) OBRIGHEIM NUCLEAR POWER PLANT ANNUAL REPORT, 1967. (Kernkraftwerk Obrigheim G.m.b.H., Stuttgart (West Germany)). Nov. 1968. 134p. (In German). Dep.

Construction and development activities from March 15, 1965, to the end of 1967 are summarized. Almost all construction work and 80 to 85% of the mechanical and electrical assembly were completed. Preparations for startup were initiated, and the pressure and leak tightness tests on the reactor building were successful. Fuel element fabrication was completed, and 32 elements were delivered to the reactor. On-site personnel, water consumption, and power consumption data are given. Drawings and photographs are included. (auth)

11115 (GEAP-5645) DEVELOPMENT PROGRAM ON THE GARIGLIANO NUCLEAR REACTOR. Final Report. Oliva, D.; Howard, C. L.; Duckart, A. C. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). July 1968. Contract AT(04-3)-189. 151p. (EURAEC-2078). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Topics discussed include: data logging and computer system; pressure vessel sample irradiation; instrumented assemblies; core evaluation studies; measurement of cross power distribution; safeguards studies; and plant systems tests. (D.C.C.)

11116 (HN-189(Rev.)) SOME CONSIDERATIONS IN EARTHQUAKE RESISTANT DESIGN OF NUCLEAR POWER PLANTS. Williamson, R. A. (Holmes and Narver, Inc., Los Angeles, Calif.). Mar. 1967; Revised June 1968. Subcontract 2813. 300p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

Earthquake resistant design of nuclear power plant is detailed. The response of reactor structures to earthquake ground motion is discussed; methods of determining response are considered. Velocity and response spectra are shown; Fourier and response spectra are compared. Strength and ductility of structural components are discussed; resistance-deflection characteristics are shown for systems with one degree of freedom; hysteresis is shown for various forms. Structure-foundation interactions are considered; vibratory response and differential displacement of the structure are evaluated. Protection of the structures against fault slippage and sudden rupture, which is the result of earthquakes, is discussed. The reserve margins of safety, with respect to earthquakes, for power reactors is outlined. Use of explosive-generated ground motion for information on protective construction is discussed, briefly; dynamic testing of structural behavior under shock and vibration conditions is described. Economics of seismic-resistant design is considered. Typical building code requirements for earthquake regions are outlined. Design considerations for seismic and faulting displacement protection of nuclear power plant safety features are discussed. Seismic design criteria for nuclear power plants are given; criteria developed for San Onofre, Connecticut Yankee, and Malibu are tabulated. Areas where seismic design improvements are needed are outlined. Effects of soil on dynamic behavior of a reactor containment system are analysed; estimated seismic reserve margins of piping systems are given. Isolation materials and their properties are described. The recommended lateral force requirements of the Seismology Committee of the Structural Engineers Association of California are included. 155 references. (M.L.S.)

11117 (JPRS-47209) NUCLEAR POWER PAPERS FROM SEVENTH WORLD POWER CONFERENCE, MOSCOW, 20–24 AUGUST 1968. Translation of papers from the 7th World Power Conference, Moscow, 20–24 August 1968. 90p. CFSTI.

Separate abstracts are included for 3 of the 5 papers presented. Two of the papers were previously included in NSA and may be found in the Report Number Index as: AEC tr-6991, and AEC tr-6992. (D.C.C.)

For abstracts of individual papers see: 11118, 11119, and 11165.

11118 (JPRS-47209, pp 32-56) AN ATOMIC POWER PLANT WITH TWO REACTOR BLOCKS OF 440 MW EACH (APP 2 x 440 MW). Stekol'nikov, V. V.; (and others). Translation of Paper No. 69 from the 7th World Power Conference, Moscow, 20–24 August 1968.

A power plant with two 440 MW units is described and its technical characteristics are presented. The plant incorporates water-water reactors and advanced types of the Novo-Voronezh reactor. The operating conditions of the WWR-440 reactor are given and the installation of the power plant is described. A short description of the testing and startup program is also given. (auth)

11119 (JPRS-47209, pp 57-73) CZECHOSLOVAKIA'S ROAD TO THE DEVELOPMENT OF ATOMIC ENERGY. Gulovets, Ya.; (and others). Translation of Paper No. 164 from the 7th World Power Conference, Moscow, 20–24 August 1968.

The state of development of nuclear power plants in Czechoslovakia is discussed. Power requirement predictions to 1990 are presented. The Bohunice Power Reactor Unit 1 development and construction progress is described. The possibilities for future development of this reactor type are pointed out. (D.C.C.)

11120 (KFK-tr-275) LARGE NUCLEAR POWER PLANTS FOR SIMULTANEOUS GENERATION AND DESALTING. Curin, A. I.; Kljacko, V. A.; Korjakin, Yu. I.; Solov'ev, G. M.; Loginov, A. A.; Rybacev, V. V. Translated into German by Rosemarie

Corssen (Kernforschungszentrum, Karlsruhe, Ger.), from a Russian paper. 18p. (In German). Dep.

Technical and economic aspects of operation of graphite-moderated and water-cooled nuclear reactors (tube type) and fast breeders in combination with desalting plants are considered. Specific features of operation of superpower nuclear reactor systems at multi-purpose plants for electric power, heat and fresh water production are described. Plant flowsheets are given. Economic characteristics of the nuclear power generating and desalting sections are described over a wide range of reactor system thermal power changes. Electric power prime cost and specific capital investments in nuclear power plants are given as a function of thermal power of the reactor systems concerned. Specific capital investments in the desalting equipment, and operating cost as part of the distillate prime cost are also given as a function of the plant capacity. The economic competitiveness of multi-purpose nuclear plants and their role in electrical systems are analyzed. (auth)

11121 (NUS-394) DRY SIPPING OPERATIONS AND RESULTS AT THE ELK RIVER REACTOR DURING MAY 1967. Duvall, F. C.; Negin, C. A. (NUS Corp., Washington, D. C.). Sept. 1967. 37p. Dep. CFSTI.

During the latter part of 1966 and early 1967 sharp increases in coolant fission products indicated that one or more fuel defects had occurred. Equipment was designed and procedures prepared to permit detection of failed fuel elements by the dry sipping method. This method was chosen based on favorable reports of initial demonstration at Dresden and Humboldt Bay in 1965. The sipping fixture and associated equipment were fabricated by Elk River site personnel. In May 1967, the core was unloaded and each element was individually tested for fission gas release using this equipment. Of the 147 elements tested, twenty-two were found to have cladding defects of sufficient magnitude to permit detection of fission gas release by the monitoring instruments. The equipment performed well and fuel defects were readily detected by the site operating personnel. (auth)

11122 (NUS-TM-ES-5) OPERATING PROCEDURES AND REVIEW OF THERMAL ASPECTS OF THE DRY SIPPING METHOD FOR FAILED FUEL DETECTION, ELK RIVER REACTOR. Lang, Peter M.; Lindbeck, S. Lloyd (NUS Corp., Washington, D. C.). Mar. 24, 1967. 14p. Dep. CFSTI.

In the development of the "dry sipping" technique for detection of failed fuel elements, topics discussed include: the criteria for determining the soaking time; possible thermal shock to the fuel element upon re-entry of water to the canister; design of the fuel element thermocouple; safeguards against fuel failure which could be induced by excessive heatup during the test; operating procedure for the dry sipping operation; and procedures for pre-operational test to ensure properly functioning apparatus. (D.C.C.)

11123 (NYO-3250-27) THE NUCLEAR DESIGN OF THE CONNECTICUT-YANKEE REACTOR. McGaugh, J. D. (Connecticut Yankee Atomic Power Co., Haddam. Westinghouse Electric Co., Pittsburgh, Pa. Atomic Power Div.). Oct. 1968. Contract AT(30-1)-3250. 129p. Dep. CFSTI.

The nuclear design characteristics of the Connecticut-Yankee first core are presented. These include data for reactivity, power density distributions, reactivity control, depletion, and kinetics. The methods used to analyze the core are described, and the bases for confidence in these methods are presented. (auth)

11124 (RCN-98, pp 409-25) THE APPLICATION OF THE NOISE ANALYSIS WHEN INVESTIGATING THE BOILING WATER REACTOR DYNAMICS. Kebadze, B. V.; Gryazev, V. M.; Sokolov, I. N.; Afanas'ev, V. A.; Adamovskii, L. A. (Research Inst. for Nuclear Reactors, Melekess (USSR)).

Some results of the dynamic investigations of the boiling water reactor by means of the noise analysis are presented. The dynamic behavior of the VK-50 reactor, the instrumentation, and methods of data reduction are briefly described. The investigation of different parameters at different reactor operating conditions, including those near the limit of stability, is discussed. The use of the damping time constant of the neutron flux correlation function for predicting the stability limit is demonstrated. Interpretation of the power spectral densities, with a number of thermophysical parameters, gives additional information about the dynamic behavior of the natural circuit circulation which is rather difficult to obtain by means of oscillatory methods. The instrumentation is analyzed using statistical methods. (auth)

11125 (WAPD-PWR-TE-205) SHIPPINGPORT PWR CORE 2 SEED 1 PHYSICS TEST RESULTS FROM BEGINNING-OF-LIFE TO MID-LIFE TEST EVALUATION. Smith, F. E. (Bettis Atomic Power Lab., West Mifflin, Pa.). Sept. 1968. Contract AT(11-1)-Gen-14. 77p. Dep. CFSTI.

The results of physics tests conducted during the first half of PWR Core 2 Seed 1 lifetime are presented. The period of these tests covers operations from initial criticality in February 1965 to the completion of about 5900 equivalent full power hours in October 1966. These tests have provided information on critical rod positions and reactivity worths, temperature coefficients, xenon transient characteristics, core reactivity symmetry, and reactivity loss rates. Calculated characteristics of the core were found in general to be in good agreement with the measured nuclear characteristics. (auth)

11126 FITTING NUCLEAR PLANTS INTO SYSTEM PLANNING. Smith, Earl O. Power Eng., 73: 52-5(Jan. 1969).

The use of digital computers to simulate optimum power reactor development programs is described. The use of fuel cycle costs as input information serves as computing factors. (D.C.C.)

11127 OPTIMAL CONTROL OF A NUCLEAR REACTOR. Sato, Kohei (Electrotechnical Lab., Tokyo). Denki Shikenjo Kenkyu Hokoku, No. 677, 117(Dec. 1967). (In Japanese).

The present state of optimal control of nuclear reactors and nuclear power plants is surveyed. Brief descriptions of optimization theories which have recently made remarkable progress are presented. Synthesis of automatic control systems suitable to the large scale nuclear power plants is treated. A modified non-interacting control system is introduced for the nuclear power plants. Xenon poisoning control is described. The optimization of the steady-state neutron flux and absorber distribution is described. The power flattening for various reactors is taken up as an example of the optimalizing problem and it is demonstrated that the method developed is quite useful. (NSA of Japan)

11128 IS A CHANGE OF STRUCTURE IN POWER DISTRIBUTION SYSTEMS TO BE EXPECTED DUE TO THE TRANSITION TO POWER GENERATION IN NUCLEAR POWER STATIONS? Roggendorf, Alexander. Elektrizitaetswirtschaft, 67: 49-52 (Jan. 29, 1968). (In German).

The problems arising in present power distribution and interconnected systems in the German Federal Republic are listed. Attention is called to consumption near the point of generation, and to generation near the fuel source. There is also a discussion of the possibilities of power generation based on heavy fuel oil, which has been taken up in recent years. The effect of future nuclear power stations on the further development of systems is considered. An increase in power generation near centers of consumption is expected in the future; the results of this are outlined. (auth)

11129 EUROPEAN ATOMIC INDUSTRY AND ITS MARKET. Ehrentreich, J. (EURATOM, Brussels); Pantleon, M. Atomwirt., Atomtech., 14: 45-52(Jan. 1969).

Saturated steam turbines for nuclear power plants are described. Turbine design data for each of the power reactors throughout Europe are tabulated. Corrosion-erosion effects and erosion on the low-pressure side of the turbine are discussed. Requirements for saturated steam turbines are tabulated as a function of power and condenser pressure. Effects of load loss on the turbines are considered. Gas turbines for high temperature gas cooled power plants are discussed. A list is given of turbine manufacturers located in: Germany, Belgium, France, Italy, and The Netherlands. 16 references. (M.L.S.)

11130 PRACTICAL PROBLEMS OF RADIOLOGICAL PROTECTION IN NUCLEAR POWER STATIONS. Delpla, M. Rev. Fr. Energ., No. 199, 239-62(Mar. 1968). (In French).

A few fundamental concepts concerning ionizing radiation are described. The operating principle of a power station, and the situating of sources of ionizing radiation are analyzed. Methods of protecting people from radiation (during normal operating conditions and under accident conditions) are described. (Sum. Articles Fr. Tech. Press)

11131 TESTING THE OLDBURY VESSEL MODEL. Hornby, I. W.; Verdon, G. F.; Wong, Y. C. (Central Electricity Research Labs., Leatherhead, Eng.). pp 461-8 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The testing of a 1/8th scale model of the prestressed concrete pressure vessel used for the Oldbury nuclear power station is described. Three phases of testing are described: elastic—prestressing and pressure loading up to 442 psi; thermal testing—the effect of a 30°C temperature gradient across the vessel wall, with and without pressure loading, and an assessment of long-term behavior from a 60-day test under combined thermal and pressure loading; ultimate test—the model was fully instrumented, using

internal and external strain measuring devices, so that a detailed comparison with experimental measurements and predicted values might be made. (auth) (UK)

11132 CORRELATION BETWEEN THEORY AND EXPERIMENT: WYLFA VESSEL. Langan, D. (Taylor Woodrow Construction Ltd., Southall, Eng.). pp 435-46 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The need is explained for extensive experimental work to support and confirm the analysis and design of the Wylfa vessel as well as to provide data to satisfy specific requirements. The problems associated with the design are briefly presented and lead to a description of the comprehensive program of work carried out for the twin 96 ft diameter spherical pressure vessels. The following are described: photoelastic and strain-gauged epoxy resin models to study the general behavior of different shapes and the effect of ribs; large-scale concrete models to study the behavior under working conditions where penetrations and the standpipe zone were simulated; concrete models to study ultimate load behavior; miscellaneous investigations, which include the study of the heavily perforated top cap of the vessel, stress concentrations around lined holes, reinforced concrete in direct tension, surface reinforcement when the concrete has suffered extensive creep strain, and concrete anchor blocks under short- and long-term loading. Selected results are given showing the agreement between theory and practice, with particular emphasis on the $^1/_{12}$th scale spherical model. Methods of overcoming problems in the correlation such as creep, thermal effects, and gauge errors are discussed, and assessments made of the likely experimental errors. (auth) (UK)

11133 ELASTIC ANALYSIS OF THE DUNGENESS B VESSEL. Thorp, D. E. pp 363-73 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The purpose and limitations of the elastic analysis are briefly discussed, and a description is given of the computer programs used. The assessment of the loads applied by the tendons, gravity, and internal pressures, and of the effect of thermal gradients, are outlined, and the assumptions made in compiling the computer input data are described. The results of the analytical work for the various loading cases are summarized and the acceptability criteria for concrete under uniaxial, biaxial and triaxial states of stress are discussed. The critical stresses are assessed in accordance with the criteria, and the amounts of bonded reinforcement required are indicated. (auth) (UK)

11134 MATHEMATICAL AND COMPUTER TECHNIQUES USED IN THE OLDBURY VESSELS. Keller, A. Z.; Crump, A. R. (Nuclear Power Group Ltd., Knutsford, Eng.). pp 301-5 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

An account of the main mathematical and computer techniques used in the elastic analysis of the Oldbury pressure vessels is given. The main computer program, MYSTIC, used in the analysis is described. This was written in "User Code" for the KDF9 computer. The basic finite difference equations which the program solves by Gaussian elimination are derived using an integration technique which preserves static equilibrium for each mesh element. Equivalent body forces and appropriate boundary conditions are determined from structure self weight, prestressing tendons including frictional forces, and internal gas pressure. In the course of the analysis approximately 25 hr of KDF9 machine time were used. Future developments include the writing of design programs using a modular principle. Increased use of advanced programs together with specialized peripheral equipment will give the engineer greater design freedom. (auth) (UK)

11135 RUPTURE DESIGN OF THE OLDBURY VESSELS. Harris, A. J.; Hay, J. D. pp 307-9 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Modes of failure of cylindrical vessels and the requirements of the tendon layout are discussed. The helical arrangement of tendons adopted for the Oldbury vessels, and the relation of this layout to ultimate conditions are described. A summary of the calculations for the ultimate load design is given. (auth) (UK)

11136 ANALYSIS OF VESSEL STRUCTURES WITH PARTICULAR REFERENCE TO WYLFA. Zbirohowski-Koscia, K.; Carlton, D. (Taylor Woodrow Construction Ltd., Southall, Eng.). pp 311-21 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The methods of elastic and plastic analyses which were developed for the study of the Wylfa pressure vessel are described. The elastic analysis and design were carried out by the computer programs specially developed for the non-cylindrical pressure vessels. The program analyses vessels of spherical interior and stepped cylindrical exterior with and without ribs. The analysis is carried out by considering the structure to consist of up to 50 elements and satisfying the compatibility relation between them The loading of the vessel during construction, prestressing, commissioning, working and fault conditions can all be considered. It is also possible to include the effect of the creep of concrete with time. Stresses and deflexions are produced for all the individual loadings and as many factored combinations of these as may be desired. Sufficient information is produced to enable the reactor designers to include the vessel effects in their calculations for plant work, as well as giving the pressure vessel engineer confidence in his design. The plastic methods of analysis are applied for the purpose of estimating the safety factor of the vessel and the mode of its possible failure. Reference is made to relevant tests on concrete pressure models at working conditions, overload conditions, and at failure. The correlation between theoretical and experimental results is examined. (auth) (UK)

11137 ULTIMATE ANALYSIS OF THE DUNGENESS B VESSEL. Finigan, A. pp 323-8 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Alternative failure mechanisms of a thick concrete cylinder with flat end slabs are described, and the most probable mechanism obtained from the relative amounts of prestressing, vertically in the walls, horizontally around the end slabs, and around the walls. The ultimate strength of the cylindrical portion is calculated, and the moment equilibrium of a complete sector of the thick end slabs is obtained using simple assumptions. The major problem of assessing the shear resistance of cracked circumferential sections of the thick end slabs is discussed, and in particular the effect of the heavily perforated central zone on the shear resistance of the circumferential section immediately encompassing it. Reference is made to the model tests undertaken to confirm the overall failure mechanism and to establish the likelihood of a premature shear failure of the thick perforated end slabs. (UK)

11138 DEVELOPMENT OF THE PRESTRESSING SYSTEM FOR THE WYLFA VESSELS. Dawson, P. (Taylor Woodrow Construction Ltd., Southall, Eng.). pp 259-65 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The 36/0.6 in. Freyssinet prestressing system is described, which was developed specifically for the prestressed concrete pressure vessels at Wylfa nuclear power station. The criteria which led to the selection of this system are outlined and a general description is given of its principal components. During a comprehensive program of test work, further development of the components was undertaken, particular attention being given to the ultimate strength of the system. The tests, their results, and the development are reported. The difficulties encountered in developing an anchorage capable of realizing the loads required are described, and the development of the fluted anchorage is discussed. Consideration is also given to the detailed design of the other components of the system, including the anchor block, stressing equipment, trumpet piece, and ducts, both in the vessel ribs and the vessel itself. A summary and discussion is presented of the numerous tests made to establish the friction coefficient between strand and duct under various surface conditions, and the measures taken to protect the prestressing system against corrosion, both before and after the prestressing operation. (auth) (UK)

11139 PRESTRESSING SYSTEM FOR REACTORS. Harvey, J. T. C. pp 267-72 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The steps leading to the development of the sophisticated 12/0.6 in. Freyssinet system used in the Oldbury vessels are described

and also the way this was later grouped into a triple 36/0.6 in. arrangement for the Wylfa vessels. The influence on the anchorage efficiencies of such factors as strand characteristics, unique and mixed strand reels, lubricating and coating materials are examined statistically, and reference is made to the comprehensive test program carried out, including the dynamic loading tests for which special fatigue testing equipment was produced. The anchorages, of forged alloy steel, demanded a high degree of skill from the forging industry; predicted variations in tolerance and unexpected variations due to manufacturing problems are discussed. The design of the 250 ton tensioning jack, working at very high hydraulic pressure, with its special accessories, is described. Reference is made to a new "Kilo Ton" system for cables of 1000 tons initial testing force, due to be completed by 1970. (UK)

11140 THE OLDBURY VESSELS. Brown, A. Houghton (Nuclear Power Group Ltd., Knutsford, Eng.); Darton, A. J. pp 3-11 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The Oldbury power station is briefly described, including site location, topography and geology. Reasons are given for the adoption of prestressed concrete pressure vessels, together with the effect on plant layout and safety. Design and associated research and development are outlined. A description is given of the arrangement of the vessel, and the prestressing system, and of the general planning and methods of development of its construction. The foundation engineering and methods of construction, including ground water control, are stated very briefly. A description of the construction of the vessel includes site organization, temporary works, sequence of operations, cable duct fixing, concreting methods and plant, cable threading and stressing, and testing during construction and on completion. Expected and unexpected difficulties experienced during construction are discussed. (auth) (UK)

11141 THE WYLFA VESSELS. Taylor, R. S. (Taylor Woodrow Construction Ltd., Southall, Eng.). pp 13-19 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The two 96 ft dia spherical pressure vessels at Wylfa are described. Details are given of the main features of the construction including the concrete work, the prestressing system, the liner and cooling/insulation system, and the various penetrations, which range in size up to 10 ft 3 in. dia. The reasons leading to the selection of this particular design are given, against the background of prior development work. The method and sequence of construction are described, and particular reference is made to various construction problems, and the means by which they were solved. (auth) (UK)

11142 THE DUNGENESS B VESSELS. Warner, P. C. (Atomic Power Constructions Ltd., Sutton, Eng.). pp 21-7 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Each reactor for Dungeness B is contained, along with its boilers and circulators, in a concrete pressure vessel. The AGR design places requirements on the concrete pressure vessel designer not previously encountered in Magnox reactors, notably those associated with the close standpipe pitch and those associated with the higher gas temperatures. These new problems are commented upon, and the basis of the choice of a cylindrical rather than a spherical vessel is briefly explained. Reference is made to the design and development work. The method of constructing the vessel is described together with the arrangements proposed for prestressing and for proof testing. (UK)

11143 PRESSURE VESSELS FOR ELECTRICITE DE FRANCE NUCLEAR POWER STATIONS. Lamiral, G.; Bonelle, R.; Vaujour, J. A.; Rougier, A. (Electricite de France, Paris). pp 29-33 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The prestressing technique used is illustrated by a description of the last three pressure vessels constructed: St. Laurent II, Bugey I, and Fessenheim I. Information is given on the geometry of the vessels, the materials used, and the prestressing methods employed. Studies already undertaken should enable the properties of the materials, and their change with time, to be determined. (UK)

11144 LINER DESIGN AND DEVELOPMENT FOR THE OLDBURY VESSELS. Hardingham, R. P.; Parker, J. V.; Spruce, T. W. (Nuclear Power Group Ltd., Knutsford, Eng.). pp 661-70 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The principal features of the steel liner used in the vessels for the Oldbury-on-Severn power station are described. Factors governing its design, and the theoretical and experimental approaches which led to the particular design details adopted are discussed. A large proportion of this work consisted of experimental investigations into the behavior of panels under biaxial compression to strains beyond yield, and the equipment for this plate-buckling and associated test work is described. The effects of manufacture and erection sequences on the design are discussed and consideration is given to possible design and construction developments for future vessel liners. (UK)

11145 INTERACTION BETWEEN A PRESSURE VESSEL AND ITS LINER. Chapman, J. C. (Imperial Coll. of Science and Tech., London); Carter, A. pp 685-91 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The method of connecting the liner to the pressure vessel for Dungeness B, and some of the experimental and analytical investigations on which the design was based, are described. The load and deflection of the liner, when subjected to applied uniaxial strain, was determined analytically, and an experiment on a biaxially strained panel is reported. Load/slip curves are given from push tests on shear connectors, and the results of an experiment to determine the anchorage strength of a hoop are also given. Bearing tests on the corner bar are reported. The results of the experimental investigations are incorporated in an analytical investigation of the interaction between vessel and liner. It is concluded that a 0.5 in. thick liner is satisfactory, having regard to the buckling of the liner and to load dissipation in the concrete. (auth) (UK)

11146 INSULATION DESIGN AND DEVELOPMENT FOR THE OLDBURY VESSELS. Hughes, J. W.; Furber, B. N. V; Laing, G. W.; Armstrong, E. (Nuclear Power Group Ltd., Knutsford, Eng. Darchem Engineering Ltd., Stillington, Eng.). pp 703-13 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The development of a stainless steel foil insulation constructed to form cells containing the coolant gas is described. The dominant influence of gas circulation and leakage within the insulation was demonstrated, and it was shown that tests on small samples were completely inadequate. A theory was derived and used to extrapolate rig results to the conditions in the walls and roof, and to the much coarser cell structure of the reactor floor. Future development proposals are summarized. (UK)

11147 CORROSION PROTECTION OF THE WYLFA VESSEL COOLING SYSTEM. Barber, D.; McLelleand, G. S.; Seaton, A. R. (Nuclear Design and Construction Ltd., London). pp 725-33 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The importance of corrosion protection during design, manufacture, construction, and operation is stressed. Attention is drawn to the special problems raised by irreplaceable parts, such as the standpipe cooling jackets and liner piping. The external circuits must also be considered, as they contribute to the overall integrity of the system. The choice of methods of preoperational corrosion protection is affected by such factors as pipe joint design, methods of prefabrication and construction, and also by commissioning requirements. The method of operational corrosion protection is affected by the presence of nuclear radiations, and due account must be taken of these when choosing the cooling-water treatment method. (UK)

11148 PRODUCTION OF NUCLEAR POWER IN EUROPE DURING 1967. Elektrizitatsverwertung, 43: 166-7 (May 1968). (In French).

A summary of 1967 power production for Europe is given. Data are given for: Belgium, Germany, France, Italy, Sweden, and Great Britain. Operations summaries are presented. (M.L.S.)

11149 FUTURE PROBLEM OF ELECTRICITY MANAGEMENT IN GERMANY. ATOMIC ENERGY AND ITS ORGANIZATION.

Keltsch, E. (Nordwestdeutsche Kraftwerke AG, Hamburg). Atomwirt., Atomtech., 14: 18-20(Jan. 1969). (In German).

Electricity production and distribution in Germany is discussed. Organization of production, the establishment of a network and fitting the power plants into the net are considered. Location of nuclear power plants near load centers is discussed. (M.L.S.)

11150 NUCLEAR POWER STATION IN VIEW OF ELECTRICAL POWER SYSTEM. Tsuzuki, Takashi (Ministry of International Trade and Industry, Tokyo). Genshiryoku Kogyo. 14: No. 7. 8-11(Julv 1968). (In Japanese).

The economics of atomic power generation, as viewed from the general power supply systems, are described in the following: propositions from the Electric Power Enterprise Council (promotion of the development of atomic power generation, and enforcement of the large-area power supply operation); atomic power generation viewed from the general power supply systems (atomic power generation and its limits); future problems (reduction in the construction period, establishment of the operation and maintenance techniques, development of safety techniques, sites near major cities, acquisition of uranium supplies, and regional developments and atomic power generation). (NSA of Japan)

11151 WILL THE TRANSITION TO NUCLEAR POWER GENERATION LEAD TO RESTRUCTURING OF DISTRIBUTION SYSTEMS? Roggendorf, Alexander (Technisches Vorstandsmitglied der Grosskraftwerk, Mannheim, Ger.). Elektrizitaetswirtschaft, 67: 49-52(Jan. 1968). (In German).

The present energy distribution networks in Germany are discussed. Effects of siting of nuclear power plants away from load centers are considered. Suitability of the presently existing distribution networks for accommodating nuclear power plants is discussed. (M.L.S.)

Power Reactor Development

Refer also to abstract 10234.

11152 (AEC-tr-6974) SOME TECHNOLOGICAL PROBLEMS OF FAST NEUTRON REACTORS. Pinkhasik, M. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). Translated from 7th World Conference on Power, Moscow, 20-24 August 1968. 5p. Dep. CFSTI.

A survey of technological experience and problems with Na cooled fast breeder reactors is given. The use of large Na cooled fast reactors for power production is discussed; the economic incentives for this type of power reactor are considered. (M.L.S.)

11153 (ANL-7500) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, SEPTEMBER 1968. (Argonne National Lab., Ill.). Oct. 29, 1968. Contract W-31-109-eng-38. 139p. Dep. CFSTI.

Highlights of project activities are summarized for the month of September 1968. Fuel development programs for the LMFBR are described. Operations of the ZPR-3 for LMFBR physics developments during September 1968 are also described. Operations for the EBR-2 are presented. Nuclear safety studies, including TREAT operations, and chemical separation activities are discussed. (D.C.C.)

11154 (ANL-7513) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, OCTOBER 1968. (Argonne National Lab., Ill.). Nov. 27, 1968. Contract W-31-109-eng-38. 144p. Dep. CFSTI.

Highlights of project activities are summarized for the month of October 1968. Fuel development programs for the LMFBR are described. Operations of the ZPR-3 Assembly 51 and series of Assembly 52 for LMFBR physics developments during October 1968 are described. ZPR-6 and ZPR-9 operations are also described. A review of ZPPR operations during October 1968 is presented. Operations for the EBR-2 are described. Nuclear safety studies, including TREAT operations, and chemical separation activities are discussed. (D.C.C.)

11155 (CONF-680419) PROCEEDINGS OF THE NATIONAL TOPICAL MEETING ON FAST REACTOR SYSTEMS, MATERIALS, AND COMPONENTS, CINCINNATI, OHIO, APRIL 2-4, 1968. Niemuth, W. E.; Weissenberg, J. F. (eds.) (American Nuclear Society. Southwestern Ohio Section). 479p. Dep. CFSTI.

Separate abstracts are included for 20 of the 24 papers presented. Four of the papers were previously included in NSA and may be located in the Report Number Index as: BNWL-SA-1550; ORNL-TM-2258; BNWL-SA-1750; and BNWL-SA-1754. (D.C.C.)

For abstracts of individual papers see: 10234, 11080, 11081, 11156-11164, 11192, 11193, 11237, 11245, 11263, 11264, 11281, and 11308.

11156 (CONF-680419-, pp 3-8) THE OBJECTIVES AND STATUS OF THE AEC-SPONSORED 1000 Mwe LMFBR FOLLOW-ON STUDIES. Fromm, L. W.; Burelbach, J. P.; Lutz, D. E.; Thompson, D. H. (Argonne National Lab., Ill.).

The development program for the AEC-sponsored 1000 MW(e) LMFBR is described. The objectives of the program are listed. Follow-on studies are described. (D.C.C.)

11157 (CONF-680419-, pp 63-88) FACTORS AFFECTING THE DESIGN OF GAS-COOLED FAST BREEDER REACTORS. Melese-d'Hospital, G. (Gulf General Atomic, Inc., San Diego, Calif.).

Gas-cooled fast breeder reactors are characterized by a great design flexibility because of the decoupling of gas temperature and pressure, the small coolant nuclear interaction, and the lack of chemical and neutron activation of He. Performance, such as 10 years doubling time or 40% thermal efficiency, comparable to those of high-gain oxide-fueled LMFBR, are obtainable with GCFR at modest pressures (70 to 100 atm) and pressure drops ($\Delta p/p$ = 5%) for maximum clad temperatures of 650 to 700°C. Besides the advantage of easier gas technology compared to Na, GCFR can benefit from better fuels such as carbides and from the simpler direct gas turbine cycle. 13 references. (auth)

11158 (CONF-680419-, pp 89-110) THE WESTINGHOUSE 1000 MWe FOLLOW-ON STUDY, TASK I: TRADE-OFF STUDIES. Anderson, Carl A. Jr. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.).

Technical and economic comparisons, or trade-off studies, are reported for several design features of a 1000 MW(e) liquid metal fast breeder reactor. The design features selected are: a four-module core, fuel vented to coolant, combined hot-cell refueling and containment, two heat-removal loops, a piped primary system, and a non-reheat steam cycle. 6 references. (auth)

11159 (CONF-680419-, pp 111-26) FAST STEAM COOLED REACTOR: SYSTEM PRESSURE CONSIDERATION, 300 MWe PROTOTYPE AND AN APPROPRIATE TESTBED FOR FUEL ELEMENTS. Fischer, J.; Kilian, P.; Kirchenmayer, A. (Allgemeine Elektricitaets-Gesellschaft, Grosswelzheim (West Germany)).

A system pressure of 120 atmosphere has been found suitable for the prototype of the steam-cooled fast reactor by considering economical influences and development risks. A preliminary design for the 300 MW(e) prototype is proposed. Essential features are a direct cycle, a pressure-suppression containment and a steel pressure vessel with the Löffler cycle components arranged in compact loops. For fuel testing, an all fast reactor is proposed. The core and main components can be housed in the existing pressure vessel of the superheat reactor at Grosswelzheim. 7 references. (auth)

11160 (CONF-680419-, pp 127-32) UTILITY COMPANY PERSPECTIVE ON FAST-BREEDER DEMONSTRATION PLANTS. Zitek, C. B. (Commonwealth Edison Co., Chicago, Ill.).

The reasons for U. S. utility companies showing interest in the development of full-scale fast breeder power reactors are analyzed. (D.C.C.)

11161 (CONF-680419-, pp 133-62) TECHNICAL AND ECONOMIC CONSIDERATIONS AFFECTING THE DESIGN OF AN EARLY COMMERCIAL LMFBR. Aronstein, R. E.; Casey, D. F.; Golan, S. (Atomics International, Canoga Park, Calif.).

Atomics International is one of five contractors participating in the Atomic Energy Commission's Liquid Metal Fast Breeder Reactor Follow-on Study Program. The major considerations, trade studies, and analyses leading to the selection of the AI 1000-Mwe base design LMFBR for Task I of the study are presented. The major trade studies relate to the selection of: a primary system arrangement; the number of heat transfer circuits; the core height and major process temperatures; and the fuel handling concept. The selected design features a mixed Pu-U fueled regular geometry core, a loop concept with three heat transfer circuits, and a double rotating plug fuel handling system. The reactor inlet temperature is 760°F, and the outlet temperature is 1060°F. The steam cycle is 2400 psi, 900°F, with reheat to 900°F. (auth)

11162 (CONF-680419-, pp 422-33) LMFBR SYSTEM AND COMPONENT TEST FACILITIES. Dickinson, Robert W. (Atomics International, Canoga Park, Calif.).

The need for component testing in the LMFBR program is defined by the lack of evolutionary experience and the highly accelerated requirements for reliable components. Partial system testing is a useful and almost inevitable by-product of component testing for full-size components. The gross test conditions of

maximum temperature, pressure, and rate of change and temperature transients have been tentatively established and are presented. Necessary engineering compromises are outlined, and those which cannot reasonably be compromised without derogating the value of the program are identified. It is concluded that component testing and the concomitant system testing in large LMFBR testing facilities are necessary, and that the results of design and operation of these facilities are of value to the LMFBR community in addition to that gained by test and evaluation of the test articles themselves. (auth)

11163 (CONF-680419-, pp 445-8) SOME MATERIALS PROBLEMS IN FAST REACTORS. Gurinsky, David H. (Brookhaven National Lab., Upton, N. Y.).

Problems concerned with the design and development of Na- and NaK-cooled fast reactors are briefly described. (D.C.C.)

11164 (CONF-680419-, pp 454-8) UTILITY REQUIREMENTS IN FAST BREEDERS. Zitek, C. B. (Commonwealth Edison Co., Chicago, Ill.).

The economic requirements for the development of fast breeder power reactors are analyzed as seen by the utility company. (D.C.C.)

11165 (JPRS-47209, pp 74-89) COMPUTING METHOD FOR TECHNICAL AND ECONOMIC ANALYSIS OF NUCLEAR POWER PLANTS. Dinculescu, Constantin; Danila, Nicolae; Wlezek, Camil. Translation of Paper No. 253 from the 7th World Power Conference, Moscow, 20-24 August 1968.

The use of an analog computer system to simulate and compare a nuclear power reactor with a conventional power plant is described. The computational method is described for establishing the optimum power reactor system. (D.C.C.)

11166 (KFK-tr-274) DEVELOPMENT OF ATOMIC ENERGY IN CZECHOSLOVAKIA. Gulovec, Ja.; Komarek, A.; Srb, V.; Sevcik, A. Translated into German by Rosemarie Corssen (Kernforschungszentrum, Karlsruhe, Ger.), from a Russian paper. 20p. (In German). Dep.

The status of electrical energy production in Czechoslovakia is summarized; projected requirements are tabulated for 1970, 1980, and 1990. The development of nuclear energy in Czechoslovakia is discussed; installed nuclear capacity is projected for the next two decades. Uranium resources are discussed; uranium requirements for pressurized heavy water reactors and boiling water reactors are tabulated. Design parameters for the types of reactors suitable for building in Czechoslovakia are listed; characteristics of the types of reactors are considered. (M.L.S.)

11167 (ORNL-4290) NUCLEAR ENERGY CENTERS INDUSTRIAL AND AGRO-INDUSTRIAL COMPLEXES. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 227p. Dep. CFSTI.

AGRICULTURE—agro-industrial complexes, crop-water yield relationship for
—farm systems for agro-industrial complexes, summary of model
—agro-industrial complexes, economic ground rules for
—agro-industrial complexes, crop prices and gross receipts per acre for nuclear powered
—agro-industrial complexes, factors affecting site selection for nuclear powered
—agro-industrial complexes, mathematical model for economic analysis of
ALUMINUM—production in agro-industrial complexes, effects on electricity production costs of
AMMONIA—production in agro-industrial complexes, effects on electricity production costs of
CHEMICALS AND REAGENTS—production from seawater, agro-industrial complexes for
—production in agro-industrial complexes from seawater, pre-evaporation treatment for
CHLORINE—production in agro-industrial complexes, effects on electricity production costs of
DESALTING—water yields in nuclear powered agro-industrial complexes, crop relationships to
PHOSPHOROUS—production in agro-industrial complexes, effects on electricity production costs of
POWER—production from power reactors in agro-industrial complexes, effects of production of fertilizer materials on cost of
—production from power reactors in agro-industrial complexes, effects of reactor-type on cost of
REACTORS, BREEDER—agro-industrial complexes, estimated costs of electricity and water production from
REACTORS, FAST—agro-industrial complexes, estimated costs of electricity and water production from
REACTORS, POWER—agro-industrial complex, technical and economic feasibility of
—electricity production from agro-industrial complex, effects of ammonia and phosphoric acid production
—agro-industrial complexes, effects of size on cost of
—agro-industrial complexes, economic ground rules for
—agro-industrial complexes, estimated costs of electricity and water production from
—industrial-only complexes using, economics of
—agro-industrial complexes, factors affecting site selection for
—agro-industrial complexes, mathematical model for economic analysis of
REACTORS, PROCESS HEAT—agro-industrial complex, technical and economic feasibility of
—agro-industrial complexes, economic ground rules for
—industrial-only complexes using, economics of
—agro-industrial complexes, economic effects of crops on water production in
—agro-industrial complexes, factors affecting site selection for
—agro-industrial complexes, mathematical model for economic analysis of
REACTORS, WATER-COOLED—agro-industrial complexes, estimated costs of electricity and water production from
SEAWATER—production of chemicals from, agro-industrial complexes for
—chemicals production in agro-industrial complexes from, pre-evaporation treatment for
SODIUM CARBONATES—production in agro-industrial complexes, economics of
STEEL—production in agro-industrial complexes, economics of
WATER—production from power reactors in agro-industrial complexes, effects of reactor-type on cost of
—production in nuclear powered agro-industrial complexes, economic effects of crops on (M.L.S.)

11168 (UCRL-71198) REACTIVITY SELF-CONTROL ON POWER AND TEMPERATURE IN REACTORS COOLED BY HEATPIPES. Hampel, Viktor E.; Koopman, Ronald P. (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 1, 1968. Contract W-7405-eng-48. 83p. (CONF-681101-9). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

Fluid dynamics in heatpipes are shown to transfer between 5 and 10% of the fluid mass from the evaporator end to the condenser end during normal operation as a function of radial heat flux. These effects were studied for K, Na, Li, BeF_2, Ag, and LiF in computer optimized heatpipes for mesh dimensions between 0.0075 and 0.0325 cm and for temperatures between 1300 and 2400°K. It is shown that this transfer of mass can be utilized in reactors cooled by heatpipes to yield strong negative reactivity effects when fluids with negative void coefficients are employed. (40 references) (auth)

11169 GAS-COOLED REACTOR DESIGNERS LOOK TO THE FUTURE. Int. At. Energy Agency Bull., 10: No. 6, 27-31(1968).

The development program for advanced and high-temperature gas-cooled reactors is described. (D.C.C.)

11170 DEVELOPMENT OF THE NUCLEAR POWER IN THE WORLD. Ney, W. (Biuro Projektow Energetycznych "Energoprojekt", Warsaw). PTJ, 11: 215-19(1967). (In Polish).

In the list 131 stationary nuclear power stations are included with the total capacity of some 50,000 MW. The list includes those in operation and under construction in various states of realization and a few projects to be dismantled as of September 1966. Power stations are classified according to 16 reactor types. These power stations include prototype, informative, dual-purpose and power station on industrial scale competitive with power stations fuelled with organic fuel. The construction cost is given in $/kW for each power station, taking into account costs of the research and development works connected with the construction of the particular power station. (auth) (NSA of Poland)

11171 BREEDER REACTORS. PART I. Dobkowski, Z.; Nycz, Cz. (Inst. of Nuclear Research, Warsaw). PTJ Dodatek, No. 46(267), 270p.(1966). (In Polish).

The status of breeder reactor development up to 1965 is summarized. Technical and economic aspects of breeder reactor technology such as fuel fabrication and handling, cooling systems, etc., as well as the main characteristics of different breeder reactor types and power systems incorporating breeder reactor are described. (auth) (NSA of Poland)

11172 ONLY HIGH-GAIN BREEDER REACTORS CAN STABILIZE URANIUM FUEL REQUIREMENTS. Rengel, J. C. (Wes-

tinghouse Electric Corp., Pittsburgh). Energ. Nucl. (Paris), 10: 389-91(Oct. 1968). (In French).

The rapid growth of water reactor capacity has accelerated the economic desirability of the high-gain breeder reactor. The breeder will be used in partnership with water reactors and will breed more fissionable fuel than it consumes for use in other reactors. (auth)

11173 DEVELOPMENT OF A SODIUM-COOLED FAST REACTOR. Lindhout, A. H. Atoomenergie Haar Toepass., 10: 238-41(Oct. 1968). (In Dutch).

A joint information meeting was held by the Organization for Applied Research (TNO), the Netherlands Reactor Center (RCN) and Neratom on May 16, 1968 at Delft. Research at these organizations, in cooperation with Belgian and German research institutes, is aimed toward the construction of a 300 MW(e) Na-cooled reactor prototype by 1970 and the development of similar 1000 MW(e) units at a later date. The steam generators, heat exchangers, and pumps for the Na loops will be developed at the 50 MW test stand currently under construction. Corrosion studies are carried out at Neratom and TNO, while the fuel cycle, core design and safety problems are investigated at RCN in cooperation with the Karlsruhe and Mol laboratories. The effect of fission products on the core characteristics will be studied in a fast critical experiment, using a core with a fast central area and a thermal peripheral zone. Study of the fuel reprocessing is also in progress. The heat transfer will be examined in a 75 and 350 kW out-of-reactor Na loops. The safety studies include the accidental release of radioactive aerosols. (TTT)

11174 MATERIALS FOR WATER-COOLED REACTORS. Francis, W. C. (Idaho Nuclear Corp., Idaho Falls). Contract AT(10-1)-1230. Annu. Rev. Nucl. Sci., 18: 465-94(1968).

Operating conditions for the U.S. light water reactors are tabulated; radiation environments are given. Properties and performance of fuel materials are summarized. Coolants, moderator and reflector materials, control rod materials, and structural materials are discussed. 75 references. (M.L.S.)

11175 NUCLEAR ENERGY IN CZECHOSLOVAKIA: A STUDY IN FRUSTRATION. Polach, Jaroslav G. (Resources for the Future, Inc., Washington, D. C.). Orbis, 12: 831-51(Fall 1968).

The delays in the Czechoslovak nuclear power program are examined. The fundamentals of the Soviet nuclear aid policy are outlined, and the Czechoslovak energy resource-base and pattern of energy flows are analyzed. Results of the nuclear power program and the impact of the Czechoslovak failure on nuclear cooperation in the Soviet bloc are analyzed. Soviet policy objectives in the nuclear power field are evaluated. (H.D.R.)

11176 DEVELOPMENT ON ADVANCE REACTORS. Kanai, Tsutomu; Yamada, Shuji (Hitachi Ltd., Tokyo). Hitachi Hyoron, 50: No. 7, 81-6(July 1968). (In Japanese).

The results of research and development carried out on an advanced thermal reactor, a Na-cooled fast breeder reactor, and a steam-cooled fast breeder reactor are summarized. The conceptual design is described on the advanced thermal reactor with emphasis on a fuel cycle, on the Na-cooled breeder reactor including the design study and reactor physics and Na technology, and finally on the steam-cooled fast breeder reactor including its technical feasibility and merits and demerits as compared to the Na-cooled reactor. (NSA of Japan)

Kinetics and Dynamics

11177 (AI-AEC-12705) DOPPLER AND RELATED MEASUREMENTS IN A SOFT FAST-REACTOR SPECTRUM. Springer, T. H.; Tuttle, R. J.; Otter, J. M.; Paschall, R. K. (Atomics International, Canoga Park, Calif.). [1967]. Contract AT(04-3)-701. 46p. Dep. CFSTI.

Results of investigations of the neutron energy spectrum, reactivity coefficient, and Doppler coefficient measurements in a soft spectrum fast reactor are given. Measurements on materials for the Liquid Metal Fast Breeder Reactor (LMFBR) are discussed; experimental apparatus and techniques are described. Calculational techniques for determining core neutronic characteristics are discussed; calculated spectra are shown graphically. Calculated and measured values are compared. Measurement of absolute reactivity worths is described; data are tabulated. Reactivity effects caused by heating and sample expansion are evaluated. Measurements of temperature coefficient of reactivity are discussed; reactivity worth is shown as a function of temperature. 28 references. (M.L.S.)

11178 (BNWL-919, pp 11.1-38) FAST REACTOR DOSIMETRY AND DAMAGE ANALYSIS. Nightingale, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A dosimetry experiment in the EBR-2 reactor is described. Computer simulation systems for crystalline defects analysis in α-iron and copper are described. (28 references included) (D.C.C.)

11179 (EURFNR-542) STRUCTURAL, EXPANSION, AND BENDING EFFECTS IN THE FAST REACTOR. PART III. APPLICATION TO Na-1 REACTOR. Hoang, Y. S. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translated from report KFK-539/3. 38p. (EUR-3951(Pt.3)). Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

Methods used to calculate the bending of core subassemblies in the Na-1 Reactor under various fast reactor power conditions are described. The effects of the bending on reactivity distributions are analyzed. (D.C.C.)

11180 (JUL-525-RW-RG) AN ESTIMATE OF THE CHANGE IN STABILITY OF BeO MODERATOR BALLS ON CYCLING THROUGH A 1000 MWe PEBBLE BED REACTOR. Buresch, F. E.; Rixen, W.; Hecker, R. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe. Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). June 1968. 79p. (In German). Dep.

The development of BeO as moderator material for a conceptual 1000 MWe pebble bed gas cooled high temperature reactor is discussed. Calculational procedures for determining flow velocity and neutron flux and temperature fields are described; data are presented graphically. Effects of volume expansion of the moderator pebbles are analysed. Equations for calculating the change in breaking strength of BeO under irradiation are derived. Stability of the model 1000 MWe reactor is evaluated; stability dependence on crystal size is determined for irradiated and unirradiated pebbles. 24 references. (M.L.S.)

11181 (RCN-98, pp 1-15) REVIEW OF REACTOR KINETICS WORK IN BELGIUM. Debrue, J. (ed.) (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)).

Reactor kinetics programs at the Mol, Belgium Study Center of Nuclear Energy are summarized. Techniques used to measure the kinetic behavior of the BR-2 are discussed. The criticality studies on the VENUS critical assembly are described. The pulsed neutron measurements carried out at the University of Belgium are discussed briefly. Core and plant kinetics efforts for large nuclear power plants are discussed. The study of the fast pulsed reactor SORA is outlined; fast reactor safety studies are considered. (13 references) (M.L.S.)

11182 (RCN-98, pp 17-23) REVIEW OF REACTOR KINETICS WORK IN THE NETHERLANDS. Dragt, J. B. (Reactor Centrum Nederland, Petten).

The reactor kinetics work in The Netherlands is summarized. The programs are outlined for: Wageningen, Delft, Eindhoven, GKN, and Petten. (M.L.S.)

11183 (RCN-98, pp 397-408) INFRALOW FREQUENCY POWER FLUCTUATIONS IN A POWER REACTOR. Mogilner, A. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut).

The observed noise in the ion chamber which controls neutron flux in a power reactor, contains information both about its sources and about dynamic reactor system characteristics. As a rule, the practical use of the natural noise for the qualitative determination of the reactor characteristic implies great difficulties. The essential simplicity can be reached in some limited cases. So it has been shown that in the very low frequency region the reactor with simple feedback often behaves as a harmonic oscillator with Brown forces. The use of such an ideal model, nevertheless, allows one to determine such reactor characteristics as temperature reactivity coefficient, time constant, their dependence on reactor working conditions and their evolution during operation. The effectiveness of this asymptotic model has been illustrated with the help of heavy-water boiling reactor HBWR-2. The analysis of the noise allows the estimation of the above-mentioned quantities and the thermal conductivity coefficient. Another example gives the results of the experiment when an artificial instability is produced; the simplicity of its analysis helped to determine the absolute power. (auth)

11184 (RCN-98, pp 439-58) PASSIVE STATISTICAL METHOD FOR REACTOR PARAMETERS DETERMINATION. Mirsoyan, A. R. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut).

It is shown that taking the space length into account leads to the prediction of resonances in spectral power density of neutron flux fluctuations. The analysis is carried out on the basis of a two-region reactor model. It is assumed that the main sources of

neutron fluctuations are random oscillation of the coolant temperature and the reactor power transfer function with regard to reactivity is a smooth function of frequency. It is also shown how to use the resonance frequency and width for reactor parameters determination. The results of the analysis are applied to the explanation of neutron flow noise investigation in the TES-3 reactor. As a result, the heat transfer coefficient from fuel to coolant was determined. A passive statistical method is proposed for temperature reactivity coefficient determination. (auth)

11185 (RCN-98, pp 459-91) THE STUDY OF NUCLEAR POWER REACTOR DYNAMICS BY THE METHOD OF THE STOCHASTIC OSCILLATOR. Mogilner, A. I.; Cherevatenko, V. L.; Semenisty, V. L.; Timohin, L. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut).

A method is described for measurement of pulse transient response of nuclear power reactors by calculation of the cross-correlation of the reactor reactivity and the power, modulated by a pseudorandom binary signal, simulating white noise. The method allows determination of more exhaustive information about the dynamic behavior of the reactor during a minimum period of time in the presence of noise; the possibility of automatic processing of the results and simultaneously obtaining the weighting function for a wide range of the value of the argument is evaluated. The calculated cross-correlation function approximates the necessary pulse transient response; thus the problem of introduction of a correction factor appears. Errors must be evaluated for the calculated results because of this approximation. To interpret the results obtained, one can use the mathematical space-time model which uses the separation of the reactor into several zones. This model is described by a system of heat exchange and kinetics equations. The main requirements for the instrumentation, intended for pulse transient characteristic measurement are discussed. The description of three analyzers and the pseudo-random signal generator is given. The preliminary experimental results are listed. (24 references) (auth)

11186 (UJV-2027) CALCULATIONS OF FUEL BURN-UP IN HEAVY-WATER REACTOR CONSIDERING CHANGES IN THERMAL AND EPITHERMAL NEUTRON SPECTRA. Kujal, B. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). July 1968. 7p. (In Czech). Dep.

The burnup calculations of the fuel in the outer zone of the A 2 reactor were performed with respect to the thermal and epithermal spectrum change. The influence of ^{239}Pu and ^{240}Pu isotopes accumulation on the spectrum in the lattice and the reactivity change was determined. The results (dependence of reactivity on burnup and fuel isotopic composition) were compared with those of FPV-1 program calculations based on Westcott's method of thermal cross sections. (auth)

11187 ANALYSIS OF THE STATIC POWER COEFFICIENT OF EBR-II WITH REDUCED COOLANT FLOW. Long, J. K. (Argonne National Lab., Idaho Falls, Idaho). Nucl. Appl., 6: 116-26(Feb. 1969).

A study of EBR-II operating behavior, which began with a re-examination of the thermal analysis of fuel pins under varying rates of coolant flow, incorporates the recent interpretations of the bowing behavior of the subassemblies. The nonlinear bowing effects are combined with the linear expansion effects in equations that express the power-reactivity decrement as a function of both power and flow. Comparison with experiments indicates agreement to within a few inhours. Differentiation of the equations leads to expressions for power and flow coefficients of reactivity. The reduced flow data are used to determine an effective average thermal expansion coefficient for the fuel. (auth)

11188 AN ON-LINE METHOD OF TRANSFER FUNCTION ANALYSIS IN EBR-II. Hyndman, R. W.; Tuck, M. R. (Argonne National Lab., Idaho Falls, Idaho). Nucl. Appl., 6: 137-41(Feb. 1969).

An on-line digital data reduction method has been adopted at Experimental Breeder Reactor II for transfer function analyses of reactor stability. Adoption of this system has decreased the time required to obtain experimental results, increased the accuracy of the results, and reduced the number of people required. (auth)

Control Systems

11189 CONTROL ROD INSERTION SYSTEM. (to Westinghouse Electric Corp.). British Patent 1,140,010. Jan. 15, 1969. Priority date Jan. 12, 1967, United States.

REACTOR CONTROL ELEMENTS—drives for heterogeneous reactor, description of telescoping tubular sleeves with multiple concentric spring-type

REACTORS, HETEROGENEOUS—control rod drives for, description of telescoping tubular sleeves with multiple concentric spring-type (D.C.C.)

Cooling Systems

Refer also to abstracts 9818, 10204, 10205, 10243, and 10313–10319.

11190 (BNL-13099) FISSION PRODUCT VAPORIZATION FROM SODIUM SYSTEMS. Castleman, A. W. Jr.; Tang, I. N. (Brookhaven National Lab., Upton, N. Y.). Nov. 1968. 28p. (CONF-681106-5). Dep. CFSTI.

From Conference on Sodium Technology and Large Fast Reactor Design, Argonne, Ill.

Results of analytical and experimental studies of the thermodynamic properties and transport behavior of fission products in Na are presented. Thermochemical properties required in the design of coolant-stream clean-up systems employed during reactor operation are examined. The transport properties are considered together with the limiting case of maximum release. Fission-product partial pressures above that of Na and their relative extent of vaporization are discussed. (H.D.R.)

11191 (BNL-13172) ESTIMATION OF IMPURITY LEVELS IN LMFBR FROM SOLUBILITY DATA, AND COMPARISON WITH IMPURITY BEHAVIOR IN LOOPS. Weeks, J. R. (Brookhaven National Lab., Upton, N. Y.). [1968]. 11p. (CONF-681106-6). Dep. CFSTI.

From Conference on Sodium Technology and Large Fast Reactor Design, Argonne, Ill.

The types of impurities that might be found in an LMFBR are described. The lack of available data on their binary solubilities compounded with numerous probable or possible interactions between solutes in Na makes impossible the estimation of impurity levels in LMFBR Na from solubility data. The behavior of corrosion products in corrosion loops and of fission products in DFR is cited; at the present time, this information is believed to be more useful than the available solubility data in estimating LMFBR impurity levels. (auth)

11192 (CONF-680419-, pp 244-72) LIQUID SODIUM AS A REACTOR COOLANT. Goldmann, Kurt (United Nuclear Corp., Elmsford, N. Y.).

The attainment of high breeding ratios, leading to low fuel cycle costs and conservation of our natural uranium resources, is shown to be the primary reason for selecting Na as a reactor coolant. Reliability of Na systems is discussed. Failures in existing systems, which operate at Na temperatures below 1000°F, are attributed generally to poor engineering practices rather than to a lack in Na materials technology. If further reductions in power costs are to be realized by raising Na temperatures to 1200°F to 1400°F to generate 1050°F steam, the state-of-the-art of Na technology must be extended in the areas of fuel cladding and steam generator materials and Na purity control. 112 references. (auth)

11193 (CONF-680419-, pp 326-53) COMPONENTS FOR MAIN HEAT-TRANSPORT SYSTEMS FOR SODIUM-COOLED FAST BREEDER REACTORS. Simmons, W. R. (Argonne National Lab., Ill.).

The operations and development programs of EBR-II, Enrico Fermi, SRE, and Hallam provide the bulk of U. S. experience with components for main heat-transport systems—specifically, pumps, intermediate heat exchangers, and some elements of piping systems. Some 50,000 hours of reactor operation and a few hundred thousand hours of experience with main heat-transport system components have been accumulated by these four plants. Components for SRE alone have logged 44,000 hours of Na service with over half above 500°F and some 1000 hours above 900°F. EBR-II secondary-system components and Enrico Fermi primary-system components have logged separately more than 23,000 hours. Operation performances for these components are described. 28 references. (auth)

11194 LIQUID-METAL COOLED NUCLEAR REACTORS AND ROTARY PUMP ASSEMBLIES THEREFOR. Conibeer, George William (to English Electric Co., Ltd.). British Patent 1,137,865. Dec. 27, 1968. Filed Mar. 31, 1965.

A liquid metal pump is described for use in a liquid metal-cooled nuclear reactor which includes, within the reactor tank, a reactor core and multiple pump assemblies. Each pump assembly consists of a rotary pump connected for pumping liquid metal coolant in closed circuit through the core (which is downstream of the pumps) and then through a heat-exchanger into a coolant pool in the tank. The pump is of the centrifugal, mixed-flow or axial-flow type, having its impeller mounted on a vertical axis of rotation. A

suction duct is provided coaxial with the impeller and above it and the corresponding discharge duct and pump casing exit is also coaxial with the impeller and below it. Each discharge duct includes a frusto-conical exit portion arranged to engage releasably with a corresponding frusto-conical inlet portion of a further duct for removal of liquid metal from the pump assembly. Means for allowing thermal expansion and contraction are provided. The pump assembly includes a hollow body mounted removably in a through hole in a containment structure of the reactor. The pump casing is suspended from the hollow body and the drive means is provided in the hollow body and coupled to the pump impeller. (UK)

11195 A SHIELDED ENCLOSURE PROVIDING RESISTANCE TO PRESSURES AND HIGH TEMPERATURES. Thome, Paul (to Commissariat a l'Energie Atomique). British Patent 1,140,779. Jan. 22, 1969. Priority date Jan. 26, 1967, France.

CONCRETES—pressure vessels of prestressed, description of liquid-cooled and -moderated reactor sealed and lined
PRESSURE VESSELS—prestressed concrete, description of liquid-cooled and -moderated reactor sealed and lined
REACTORS—pressure vessels for liquid-cooled and -moderated, description of sealed and lined prestressed concrete (D.C.C.)

11196 NUCLEAR REACTORS. Pearson, Robin (to Nuclear Power Group Ltd.). British Patent 1,138,069. Dec. 27, 1968. Filed Nov. 24, 1966.

The gas-cooled graphite-moderated nuclear reactor described comprises a graphite moderator core located in a concrete pressure vessel and supported on a grid structure beneath which, in the concrete vessel, are located heat exchangers for receiving hot gas from the core. Cooling gas is conveyed by gas circulators through ducts in a space between the heat exchanger and the walls of the concrete vessel to the underside of the grid structure, the gas then flows through the structure and upwards through the core in a first set of passages to a space above the core. From there the gas flows downwards through a second set of passages formed by fuel channels in the core and then through tubular extensions of these channels passing through the grid structure to a compartment located between the grid structure and the heat-exchangers. From here the gas flows through the heat exchangers and is returned to the gas circulators. The gas leaving the ducts is put into communication with passages over the whole area of the grid structure by openings formed in the walls defining the passages of the structure. The gas entering the grid structure passes through this structure and enters a space between the core and the walls of the concrete vessel, thus by-passing the core, and rejoining the gas which has flowed through the core in the space above the core. The grid structure is supported by members located in openings through which pass ducts used for conveying working medium heated in the heat exchangers outside the reactor. (UK)

11197 IMPROVEMENT IN A NUCLEAR REACTOR. (to Institutt for Atomenergi). British Patent 1,139,745. Jan. 15, 1969. Priority date June 17, 1965, Norway.

HEAT TRANSFER SYSTEMS—boiling reactor, description of restricted-flow closed-loop
REACTORS, BOILING—cooling system for, description of restricted-flow closed-loop (D.C.C.)

11198 EXAMINATION OF PRESSURE VESSELS FOR REACTORS. Beaujoint, N. (Electricite de France, Paris). pp 641-45 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

In pressure vessels for nuclear reactors possible changes in tension and embrittlement in the prestressing cables are of prime importance when considering their safety. Radiation can also cause embrittlement of unstressed reinforcement and particularly of the liner; the latter is also subject to complex and variable forces and affected by changes in pressure and temperature when the reactor is started up and shut down. The fitting of strain gauges to some non-grouted cables among those most exposed to heat and radiation constitutes the most effective means of immediate monitoring. Data from other instruments such as clinometer bobs and vibrating wire strain gauges are more difficult to analyze because of variables such as temperature, pressure and time. However, the monolithic nature of the pressure vessels, their prestressed condition, the good distribution and almost permanent nature of the loads transmitted to the foundations may assist the success of such analyses. The resemblance of one installation to another may also be an advantage. (auth) (UK)

11199 INSTRUMENTATION IN PRESSURE VESSELS. Yu, C. W. (Imperial Coll. of Science and Tech., London); Waggott, J. G. pp 627-34 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A general review of instrumentation applicable to concrete pressure vessels is given, and some of the fundamental principles are discussed. The choice of instrumentation and the interpretation of results are explained. Some experimental work is described. The difference between theory and practice is examined and some recommendations for future improvement and development are given. (auth) (UK)

11200 MEASUREMENT OF STRAIN IN CONCRETE PRESSURE VESSELS. Browne, R. D.; McCurrich, L. H. (Taylor Woodrow Construction Ltd., Southall, Eng.). pp 615-25 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Reasons are given for measuring strain in concrete both in laboratory tests and on site. Measurements are required to determine strains and stresses induced by shrinkage, elastic, and creep deformation, and thermal movements. The techniques available for strain measurement are described, and the effect on the stress distribution of embedding an instrument within the concrete is studied and related to the design of gauges. Some of the gauges at present available are described and evaluated, and information is given on the performance of the gauges used in the Wylfa program. (auth) (UK)

11201 DYNAMIC RELAXATION APPLIED TO LOCAL EFFECTS. Holland, J. A. pp 587-95 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The evaluation of bearing and splitting stresses in anchorage zones, using a three-dimensional computation, is described, and the reasons for some discrepancies in current research are suggested. An account is given of the full elastic analysis of the stress distribution in the vicinity of a radial protruding nozzle/shell intersection, including stress diffusion effects associated with partial penetration welds. The results obtained are compared with values found experimentally. (UK)

11202 STRAIN DISTRIBUTIONS AROUND OPENINGS IN PRESSURE VESSELS. Proctor, E.; Townley, C. H. A. (Central Electricity Generating Board, Berkeley, Eng.). pp 577-85 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

In order to provide an understanding of the effects of liner stiffening and reinforcement local to openings, tests were made on two models constructed at $\frac{1}{4}$ scale. A circular blower opening and a rectangular access opening were investigated. The steel liner and associated stiffening was constructed in full detail in each model, with the exception that the curved vessel liner was made in flat form. A simplified loading system was adopted in which prestressing bars were passed through the models, such that stresses in the hoop and longitudinal directions could be applied in any chosen ratio, including various degrees of bending. Electric resistance strain gauges, placed in the concrete and on the steel liner, recorded strains during the tests. The tests and the general behavior of the models are described. Strain distributions under various loading conditions are shown and discussed, and the limitations of the models are discussed with respect to actual vessel behavior. (UK)

11203 ANCHORAGE BEARING STRESSES. Taylor, S. J. (Sir Robert McAlpine and Sons Ltd., London). pp 563-76 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Research is reported on the magnitude and distribution of the tensile strains in the anchorage zone, and how these are affected by imposed states of stress and the bending stiffness of the anchorage. The strains measured in the anchorage zone were higher than those predicted by the classical theories. Imposed compressive stress produced an increase in both discontinuity (onset of rapid crack propagation) and ultimate strength, whereas applied tensile and combined tensile and compressive stresses caused a reduction in these properties. Applied uniaxial tensile stresses made little difference to the ultimate strength at lower anchorage loads, but significantly lowered the discontinuity strength. It is concluded that a failure criterion for concrete as a two-phase ma-

terial can be applied to the anchorage problem with the anchorage itself as the stiffer of the two phases. (UK)

11204 DESIGN OF VESSEL PENETRATIONS: CORRELATION OF THEORY AND PRACTICE. Tate, L. A.; Smith, J. R. pp 555-62 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The results of a theoretical stress analysis are given for a large penetration in a spherical vessel, taking into account the effect of the penetrated liner and bonded reinforcing steel. Design methods for reinforced holes in flat plates applicable to small penetrations in spherical and cylindrical vessels are discussed. Experimental work on three-dimensional and two-dimensional photoelastic and concrete models is described and the results compared with theory. Applications to the design of the Wylfa reactor pressure vessel are discussed. (auth) (UK)

11205 STRESS CONCENTRATION IN PRESTRESSED CONCRETE. Evans, R. H.; Marathe, M. S. (Univ. of Leeds, Eng.). pp 549-53 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The effect of stress concentrations around holes in concrete structures on the ultimate strength and stress/strain characteristics of structural members is examined. It is suggested that the inherent stress concentration in natural concrete is already so high that it is difficult to introduce artificial stress concentration of comparable magnitude. The tests described showed that this is the case and it is reasonable to assume that additional reinforcement around holes to compensate for theoretically induced stress concentration is unnecessary. (auth) (UK)

11206 BEHAVIOUR OF MODEL CONCRETE STRUCTURES UNDER TEMPERATURE LOADING. Lee, C. R. (Building Research Station, Watford, Eng.); Chabowski, A. J.; Miles, J. R. pp 517-25 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

An investigation of the behavior of models of the concrete primary shields at Hinkley Point nuclear power station has provided information on model techniques applied to problems of temperature loading. The models were of concrete, each mounted on a concrete block to simulate the foundation and each with embedded electrical heating mats to provide, in conjunction with superficial water sprays, the required patterns of temperature crossfall and mean temperature rise. The sprays also served to control the drying shrinkage. Repeated tests were made to compare, during alternations between uniform temperature and the required temperature pattern, the behaviors of models of two different geometrical scales ($\frac{1}{10}$th and $\frac{1}{20}$th) with each other and with the results of theoretical elastic analyses. Tests were also made with a model in which the roof had been replaced with a mechanical system for loading the walls. While the results confirmed that model techniques can be applied to problems of this nature and suggest that the theoretical analysis is equally applicable to the two sizes of model, they also demonstrate the considerable experimental variations which may occur, particularly with larger models. (auth) (UK)

11207 PRESSURE VESSEL FOR A HIGH-TEMPERATURE GAS-COOLED REACTOR. Campbell-Allen, D.; Hayes, J. E.; Low, E. W. E.; Spencer, A. (Univ. of Sydney. Australian Atomic Energy Commission, Sydney). pp 507-15 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A study of layout and costs, together with consideration of construction experience in Australia, led to the proposal for a cylindrical concrete pressure vessel for a 200 MW(e) pebble-bed HTGC to work at 1000 psi. The limiting pressures, allowable stresses, tendon arrangement, lining, insulation, and cooling are discussed in relation to the design of the vessel. Tests on scale models of flat end slabs covered a range of slab thicknesses and levels of prestress. (UK)

11208 SCALE MODELS FOR STRENGTH TESTING NUCLEAR PRESSURE VESSELS. Lida, M.; Ausangee, R. (Electricite de France, Paris). pp 497-505 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A summary is presented of the most important problems connected with pressure vessel structures, the possibilities offered by strength test models to study these problems, and their limitations; these limitations are essentially linked with the difficulties raised by scaling factor, by measurement techniques and by the lack of flexibility of the models. These questions are examined, together with the solutions which were adopted in actual cases (EDF3 and EDF4). A brief review of the principal tests carried out and of the results obtained in these particular cases enabled main conclusions to be drawn, with particular emphasis on unexpected effects which occur, knowledge of which has provided valuable information for construction work. (auth) (UK)

11209 TESTING A $\frac{1}{8}$TH SCALE CYLINDRICAL VESSEL. Price, D. C.; Hinley, M. S. pp 489-96 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The tests described were mounted to study the behavior of a cylindrical concrete pressure vessel under prestress and various conditions of internal pressure and thermal loading. The testing program covered pressure tests (including cycling) at ambient and elevated temperatures, and also elevated temperatures (including unsymmetrical heating) at zero pressure. An ultimate pressure test at ambient temperature was carried out after the top-slab cables had been removed. Deflexion diagrams are presented, and crack patterns at intermediate and ultimate pressures are discussed. Design methods and their correlation with the observed behaviour are examined, particularly with regard to the ultimate pressure tests, and factors causing differences in behaviour between the model and a full-size structure are considered. It is concluded that the design method adopted accounts satisfactorily for the behavior of the vessel in the elastic and cracking stages, that the ultimate design gave an accurate assessment of the failing pressure of the slab, and that prestress in a cylindrical pressure vessel end slab can be achieved satisfactorily using a helical cable system only. (auth) (UK)

11210 COMPARISON OF THEORETICAL AND EXPERIMENTAL TEST RESULTS FOR A RIBBED SPHERICAL VESSEL. PARTS 1 AND 2. Moncrieff, M. L. A.; Baker, A. L. L.; Arthanari, S.; Mitra, A. C. (Imperial Coll. of Science and Tech., London). pp 469-87 of Prestressed Concret Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A description is given of the deflexions and experimentally obtained stress values at critical sections of a $\frac{1}{13}$th scale ribbed spherical vessel. The results obtained by simplified theory for pressure and temperature loading are presented, and these are compared with the experimental results. (UK)

11211 USE OF STRUCTURAL MODELS IN DEVELOPING PRESSURE VESSEL DESIGN. Brading, K. F.; Hills, G. (Atomic Power Constructions Ltd., Sutton, Eng.). pp 447-59 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Tests on structural models are an essential part of the design process for a prestressed concrete pressure vessel. Frozen stress photoelastic techniques can be used, but their accuracy is limited by the error in Poisson's ratio, and the complication of representing the prestressing forces is not justified. Useful results were obtained, however, by modeling internal pressure only on a range of different geometries: variations in length, diameter, thickness, and fillet details. A model to be used as a proper design tool must be of concrete. Models in the scale range $\frac{1}{25}$th to $\frac{1}{50}$th are very useful. Even though this scale is usually too small for strain gauges, these models do provide useful information about behavior under operating loads and about onset of cracking. Their true function, however, is to investigate crack patterns in support of the ultimate strength analysis, and to demonstrate the ultimate factor. Such models must incorporate bonded and prestressing reinforcement. An early series of models representing end slabs only, and also end slabs restrained by the barrel, has given useful results about the effect of different reinforcement patterns. The technique has been developed to smaller scales using microconcrete, and in this form was applied to the design of the Dungeness B vessels, which have closely pitched penetrations in the center of the end slab and for which flexural and shear failure modes are of particular interest. Both slab tests and a complete microscale model were included in this program. (auth) (UK)

11212 PRESSURE VESSEL ANALYSIS BY FINITE ELEMENT TECHNIQUES. Rashid, Y. R.; Rockenhauser, W. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). pp 375-83 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A brief outline of the finite element procedure for the analysis of time-dependent quasi-static structures is presented. Restricting attention to prestressed concrete pressure vessels, two types of analyses are given: (a) axisymmetric analysis in which steel reinforcement, prestressing cables, and liner remain elastic, but concrete is assumed to be a linear viscoelastic material obeying the superposition hypothesis; and (b) three-dimensional elastic analysis. Viscoelastic properties of concrete are represented by an experimentally determined creep function which is temperature and age dependent. Results are presented for the axisymmetric creep analysis in the form of time-histories of stresses and deformations at specified critical locations in the structure, and as stress contour plots for the three-dimensional analysis. Comparisons of experiment with axisymmetric elastic analysis of a prestressed concrete pressure vessel model are also given. (auth) (UK)

11213 PRESSURE TEST AND EVALUATION OF A MODEL PRESSURE VESSEL. Rockenhauser, W.; Northup, T. E.; Marsh, R. O. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). pp 385-95 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The testing of a model pressure vessel is described, and comparison of test results with those predicted by theoretical analysis is summarized. The model was tested hydraulically in a series of increasing pressure cycles up to 121 atm. Results showed that strain state in a vessel subjected to internal pressure loading can be predicted with reasonable accuracy by elastic analysis, if suitable modifications are made to account for inelastic effects. It was also found that conventional limit-design techniques can be used to predict the approximate failure mode and pressure level. (auth) (UK)

11214 LONG-TERM THERMAL CREEP EFFECTS IN PRESSURE VESSELS. Lewis, D. J.; Bye, G. P.; Crisp, R. J. (Central Electricity Generating Board, London). pp 329-37 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The possible effect is shown, during subsequent shut-down, of creep strains arising during operation of the reactor. Temperature distributions through the vessel walls were obtained for a typical cylindrical vessel, both for operating and transient conditions. These temperature distributions were considered as applied to a thick concrete slab restrained from bending, and the resulting thermal stresses computed. The restrained slab is shown to be similar in thermal stress behavior to the sides of a thick-walled cylinder. The temperature gradient through the slab is assumed the same at all points, but varies with time. The thermal stresses due to the instantaneous temperature gradients at any time are compared with those derived when including creep in the calculation. It is shown that residual stresses due to creep during long periods of operation, can give rise to undesirable stress distributions during shut-downs. It is demonstrated that these undesirable stresses can be avoided to a great extent by control of cooling water flow during shut-down periods. (auth) (UK)

11215 THEORETICAL ANALYSIS OF MODEL SPHERICAL VESSEL. Orr, R. S.; Holland, D. A. pp 339-48 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The elastic analysis of a spherical, thick-walled, prestressed concrete pressure vessel is described. The method was derived for for a general six-panel spherical pressure. The shape of the vessel suggested the unusual co-ordinate system adopted, which in turn required the derivation of the equations of elasticity in this system. The solution of these equations is by dynamic relaxation, which was first devised for the analysis of the Oldbury pressure vessel and has since been found to be adaptable to many other problems. The application of this method to the six-panel sphere is described. A comparison is made of the results predicted by the analysis with the model results. (auth) (UK)

11216 LONG-TERM THERMAL STRESSES IN PRESTRESSED CONCRETE STRUCTURES. England, G. L. (King's Coll., London). pp 349-55 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The influence of creep and temperature is discussed with reference to the calculation of stresses in prestressed concrete structures. It is shown that under conditions of non-uniform temperature and stress, stress redistribution takes place and that this is accompanied by changes of redundant forces and moments which thus become time-dependent quantities. An iterative step-by-step method of calculation for the determination of these quantities is described. Under conditions of sustained temperatures and loads it is also shown that stresses, moments, and reactions will eventually stabilize, and that these steady-state quantities which result from creep may be calculated directly and without reference to the elastic modulus or coefficient of thermal expansion of concrete. The theory is presented and the method is described with particular reference to the calculation of stresses developed in the walls of a thick hollow cylinder and sphere when subjected to sustained temperatures and pressure loading. It is concluded that the steady-state stresses, together with initial stress values, form upper and lower bounds. They also provide a datum from which the behavior of a structure on cooling and unloading can readily be estimated. (auth) (UK)

11217 STRESS ANALYSIS BY THE FINITE ELEMENT METHOD: THERMAL EFFECTS. Zienkiewicz, O. C.; Watson, Margaret; Cheung, Y. K. (Univ. of Wales, Swansea). pp 357-62 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The principles of the finite element method in the displacement formulation are briefly summarized. Some details of derivation of stiffness matrices for axisymmetrical and three-dimensional solids are presented, together with recent "averaging" procedures which permit a more accurate assessment of stresses. Special attention is focused on the "initial strain" problem, including thermal effects. A brief review of the extension of the method to creep and plasticity problems is given, and the special problem of viscoelastic creep is discussed in some detail. The use of the finite element method in computation of temperature distribution is given attention. An example of a typical axisymmetrical pressure vessel is examined, for which pressure and thermal stresses are computed. In this example attention is focused on the variation of creep and elastic properties with temperature. (auth) (UK)

11218 LARGE TENDONS FOR PRESSURE VESSELS IN NUCLEAR POWER STATIONS. Ros, M. R.; Speck, F. E. (Bureau BBR, Zurich). pp 273-9 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The high prestressing forces necessary for nuclear pressure vessels are considered, and the requirements of the anchorage, tendon replacement capability, and frictional behavior are discussed. The BBRV parallel wire tendons are compared with tendons made from a number of strands and with wire ropes, and the manufacturing procedure is outlined. The BBRV anchor heads and special jacking equipment are described. The efficiency of curved tendons is discussed and test results are presented. (UK)

11219 METHOD FOR PRESTRESSING PRESSURE VESSELS. Zerna, W. (Technische Hochschule, Hanover). pp 281-3 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A method of prestressing containers under high internal pressures was developed, which eliminates most of the disadvantages of the methods applied so far. It consists of the application of individual prestressing elements carrying high prestressing forces circumferentially around the pressure vessel. The ends of each cable, which are initially not in contact with each other, are drawn together by means of a jack and then coupled. Prestressing is thus achieved. The necessity of any type of anchorage inside the body of the concrete, either during or after the prestressing operation, is totally eliminated. The method allows for the changing, one by one, of the tensioned cables without interrupting the normal operation of a reactor. Provision is made for the reduction of friction losses, or compensation for them. The thermal method of prestressing and the use of slide media are some of the solutions. In addition to the

structural advantages, this is a highly economical method of construction which results in considerable steel savings. Along with this new prestressing method, a design for a prestressed concrete pressure vessel is suggested, in which a thin shell surrounds the vessel. The annular space between the vessel and the shell is heated by hot dry air to prevent the steel from corroding and to reduce the thermal stresses in the vessel wall. The advantages of this method are explained. (auth) (UK)

11220 IMPROVED SYSTEM OF HOOPING CABLES. Scotto, F. pp 285-8 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

A particular pattern of hooping cables is described, which not only minimizes the ovalizing effects of the anchoring head reactions against the outside surface of cylindrical walls, but also utilizes these reactions to provide additional prestressing forces. The concepts outlined have been applied to a prestressed pressure vessel for a 300 MW(e) THTR. (UK)

11221 THERMAL PROBLEMS IN PRESSURE VESSEL DESIGN. Torielli, E.; Rocca, F. pp 735-7 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The criteria to be used in the definition of the effective temperature differences across the walls of a prestressed concrete pressure vessel are indicated, and the influence of the various parameters on the temperature difference is discussed. (auth)

11222 EVALUATION OF TEMPERATURE AND THE DESIGN OF COOLING SYSTEMS FOR PRESSURE VESSELS. Turton, P. J.; Hutchinson, J.; Old, R. A. B. (Atomic Power Constructions Ltd., Sutton, Eng.). pp 715-23 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The temperature distribution in the liner and in the concrete vessel is derived from a two-dimensional heat flow analysis. This is used to study the effect of the different parameters involved, namely the conductance of the insulation, the pitch of the cooling pipes, the effect of nuclear heating, the coolant velocity, the shape and size of the cooling pipes, the method of their attachment to the liner, and their distance from the liner. From such calculations an optimum arrangement can be selected. The special problems raised by cooling system design at discontinuities and penetrations are discussed. The consequences of faults in the cooling system are examined and transient heating and cooling curves presented. The integrity required of the cooling system design, and the way in which this can be achieved, are discussed. The criteria involved in the design of water cooling systems for steady-state operation are also discussed and the way in which these are met in a practical design is illustrated. (UK)

11223 LINER DESIGN AND CONSTRUCTION. Bishop, R. F.; Horseman, R. W.; White, C. M. pp 693-702 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The purpose of the liner is examined, and a review is given of possible general forms of construction. The loads induced in the liner by concrete stressing and temperature effects are described, and the possible modes of failure against which it is necessary to design are examined. The design of parts of the liner is considered, together with the fundamental background and supporting experimental work. A review of the design against failure of individual panels and anchors, and also the design of penetrations and the cooling system are included. The liners for the Oldbury and Wylfa nuclear power stations and their construction are described. (auth) (UK)

11224 DESIGN OF LINERS FOR REACTOR VESSELS. Young, A. G. (Univ. of Leicester, Eng.); Tate, L. A. pp 671-83 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The design problem is stated in general terms and the results of work, both theoretical and experimental, which was undertaken to resolve the main unknowns of the problem are presented. The main application has been to the liners of the Wylfa nuclear power station. Particular attention is paid to the design of the liner against the possibilities of rupture and buckling. Anchorage design is also studied in some detail; work on two types of anchors (continuous rib anchors and gun-welded stud anchors) is described and the choice of safety factor discussed. Design against irradiation is mentioned briefly. Methods adopted to tackle special problems which arise at penetrations through the vessel are described. (auth) (UK)

11225 PRACTICAL AND ECONOMIC DESIGN ASPECTS OF CYLINDRICAL PRESSURE VESSELS. Hay, J. D.; Eadie, D. M. pp 99-104 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The part played by the designer of prestressed concrete pressure vessels in the complex design of a nuclear reactor is discussed. The various stages of a detailed design are outlined, and the factors affecting the choice of stressing systems and the arrangement of tendons are described. Some of the problems of the design of end slabs are studied, and solutions for designs without transverse cables are suggested. An economic study and comparison of vessels of varying size and shape and for a range of pressures is made. (auth) (UK)

11226 EFFECTS OF REACTOR COOLANT CONDITIONS UPON DESIGN AND SAFETY CRITERIA FOR CONCRETE VESSELS. Bender, M. (Oak Ridge National Lab., Tenn.). pp 91-8 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Concrete vessels have been shown to be of value as primary reactor vessels in both water-cooled and gas-cooled systems. In the U.S.A., the use of concrete vessels has provided a practical solution to provision for secondary containment in large power reactors. The type of coolant used in a design is a major factor in establishing the requirements for the structure of the concrete vessel. The problems associated with the various coolants for structures used for both primary and secondary containment, and the design approaches which can be followed to obtain practical concrete structures for the particular applications, are discussed. The inherent requirements of the structure established by the components of the reactor system and its characteristics are emphasized. (auth) (UK)

11227 DEVELOPMENT OF STATUTORY REQUIREMENTS FOR REACTOR VESSELS. Anthony, R. D. (Ministry of Power, London). pp 85-90 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The safety of concrete pressure vessels is examined in relation to the safety of the nuclear plant as a whole. The prestressed concrete structure is one part of the pressure-retaining envelope, all parts of which must be designed for safety. After a brief consideration of the present position regarding safety regulations, and a comparison of steel and prestressed concrete pressure vessels, the various components of the vessel are examined in turn, and the causes of potential accidents and possible safeguards are considered. It is emphasized that while important advances have been made in stress calculation methods, design stress limits, model testing and instrumentation, it is important that the new concepts of safety should not be invalidated in practice by departures from accepted standards or lack of attention to all components. (auth) (UK)

11228 SAFETY OF PRESSURE VESSELS. Baker, A. L. L. (Imperial Coll. of Science and Tech., London). pp 79-84 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The risk of various possible modes of failure in terms of prestressing, weakness of materials, and possible over-stressing at critical points of the vessel is discussed from a statistical-probabilistic viewpoint. Consideration of initial material weakness, weakness due to working conditions, and long-term effects is included. The influence on ultimate stress values of assumptions used in calculations, of working conditions, and of long-term effects is discussed. (auth) (UK)

11229 SPECIFICATION OF CONCRETE VESSELS FOR GAS-COOLED REACTORS. Common, D. K.; Hannah, I. W. (Central Electricity Generating Board, London). pp 73-8 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The advantages and problems introduced by the adoption of concrete pressure vessels in gas-cooled reactor stations are considered from a client's viewpoint. The general approach adopted by the CEGB is described. Fundamental differences in the structural behavior of steel and concrete pressure vessels have led to a divergence between both the loading and the structural requirements of each. The need to establish separate, acceptable design criteria for concrete pressure vessels is illustrated by reference to specific features of design. An attempt is made to strike a reasonable balance between imposing conventional prestressed concrete design practice and allowing the vessel designer complete freedom, within a functional specification, in order to achieve rapid vessel development with unexceptionable margins of safety. The importance of the novel problems of liner and concrete cooling system is briefly considered. The adequacy of available data, and the aims of current research work are discussed, and possible future trends in research and design are suggested. (auth) (UK)

11230 DESIGN PHILOSOPHY AND SAFETY. Barrett, N. T.; Davidson, I. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 65-71 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

The way in which a prestressed concrete pressure vessel must behave under various conditions in order that the nuclear reactor which it contains shall remain safe is described. This is then related to the various design criteria which are commonly applied, viz., the elastic behavior under operating conditions, the gradual mode of failure, and the ultimate load factor. Particular attention is paid to the long-term effects of shrinkage and creep, and to possible deterioration either of the concrete, e.g., cracking, or of the tendon system, e.g., loss of cross section. It is concluded that in some respects the validity of the design criteria, in regard to the possible degree of integrity of the vessel toward the end of its life, is indirect, if not incomplete. This conclusion points to the need for further experiments, which have been commenced. (auth) (UK)

11231 PRESSURE VESSELS FOR HELIUM HIGH-TEMPERATURE REACTORS. Lockett, G. E.; Kinkead, A. N. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 35-43 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Plant layout for HTR's is discussed and an unconventional vessel design is described in which flange mounted boiler units are housed in the thickness of the pressure vessel wall. No analysis of the elastic behavior of such a shape was known, and a brief description is given of the methods employed in the preliminary design. A more detailed discussion of the problem in the boiler duct zone is included. (UK)

11232 PRESTRESSED CONCRETE PRESSURE VESSELS. PROCEEDINGS OF CONFERENCE, LONDON, 13-17 MARCH 1967. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968. 752p. £12. (CONF-670301).

The 63 papers presented, for which separate abstracts were prepared, relate to current practice, design philosophy, properties of concrete, prestressing steels, prestressing tendons, structural analysis, model tests, stress concentrations, instrumentation and commissioning, liners, and insulation and cooling systems. Records of the formal opening and discussions are included. (UK)

For abstracts of individual papers see: 9818, 10204, 10205, 10243, 10313-10319, 11131-11147, 11198-11231, and 11233.

11233 PRESTRESSING TENDON SYSTEMS. Burrow, R. E. D. (Taylor Woodrow Construction Ltd., Southall, Eng.). pp 251-7 of Prestressed Concrete Pressure Vessels. Udall, Marilyn S. (ed.). London, Institution of Civil Engineers, 1968.

From Prestressed Concrete Pressure Vessel Conference, London, Eng. See CONF-670301.

Some important aspects of the choice and arrangement of prestressing tendon systems for prestressed concrete pressure vessels are discussed. The specification, functional requirements and performance testing of suitable ducted prestressing systems are discussed, and some factors affecting system behavior are examined in detail. An alternative method of prestressing is also described, which provides very high concentrations of force in wire-wound external tendon bands. (auth) (UK)

Fuels

Refer also to abstracts 10197, 10240, 10255, 10270, 10271, 10295, and 10300-10303.

11234 (APDA-231) PROGRAM FOR THE DESIGN AND DEVELOPMENT OF A PLUTONIUM CORE FOR DEMONSTRATION IN A FAST BREEDER REACTOR. Interim Report, September 1, 1967-June 30, 1968. Shoudy, A. A.; Doyle, T. A. (Atomic Power Development Associates, Inc., Detroit, Mich.). Sept. 1968. 111p.

The status of the program for design and development of a PuO_2-UO_2 core, core fabrication, and plant changeover and operation of the core in the Fermi reactor is reported. Activities are summarized for: materials properties studies, fuel subassembly design, blanket subassembly design, control rod system design, nonnuclear testing, core analysis, critical experiments, analytical safety studies, irradiation programs, and operating conditions. (H.D.R.)

11235 (BNWL-919) REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. Quarterly Progress Report, July-September 1968. Bement, A. L.; Dau, G. J.; Evans, E. A.; Nightingale, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1968. Contract AT(45-1)-1830. 181p. Dep. CFSTI.

Separate abstracts are included for 9 of the 10 sections presented. The remaining section included information on the ATR gas loop operation and maintenance. (D.C.C.)

For abstracts of individual sections see: 9664, 10308, 11178, 11236, 11248, 11279, and 11351-11353.

11236 (BNWL-919, pp 6.1-3) FAST REACTOR NITRIDES RESEARCH. Nightingale, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The melting behavior of PuN-UN fuel compositions is evaluated. The effects of pressure and temperature are described. (D.C.C.)

11237 (CONF-680419-, pp 291-300) FUEL ELEMENT DESIGN AND CLADDING MATERIAL DEVELOPMENT FOR HIGH PRESSURE COOLANT FAST BREEDER REACTORS. Unneberg, Lars (Aktiebolaget Atomenergi, Stockholm (Sweden)).

The Swedish fast reactor program has so far been limited to comparative studies of different coolants. Problems of critical nature have been investigated in some detail. Calculations of creep collapse of canning tubes have been performed with a method that permits relaxation and thermal stresses to be considered. Criteria such as creep due to internal overpressure at end-of-life conditions and short time failure due to core depressurization or shut-down have also been investigated. Fuel viscosity is believed to be very important in connection with swelling and an irradiation experiment to investigate this is presented. A new series of canning materials for fast reactors is described. 5 references. (auth)

11238 (EURFNR-580) HIGH TEMPERATURE GAS COOLING FOR FAST BREEDERS. Dalle Donne, M.; Eisemann, E.; Thuemmler, F.; Wirtz, K. (Kernforschungszentrum, Karlsruhe (West Germany)). Oct. 1968. 18p. (KFK-841; SM-111/12; EUR-3978; CONF-681008-3). Dep.

From Symposium on Advanced and High Temperature Gas-Cooled Reactors, Juelich, Germany.

Work Performed under United States-Euratom Fast Reactor Exchange program.

The development of a reliable and satisfying fuel element is analyzed. Three possibilities for high temperature fuel design include: $(U,Pu)O_2$ or (U,Pu)C fuel in a vanadium alloy cladding; cermets with $(U,Pu)O_2$ particles in a chromium matrix; and ceramic coated particles. All three fuels would allow relatively high gas outlet temperatures above 720°C, which allow the use of a direct gas turbine cycle with a net plant efficiency above 40%. Nuclear calculations for 1000 MW(e) cores have been performed in order to examine the nuclear potential of these different types of fuel. In all cases the coolant pressure is considerably higher than the pressure normally used in thermal gas-cooled reactors. The special safety aspects that appear in connection with gas-cooled fast reactors are briefly discussed. (auth)

11239 (KFK-768) FUEL ELEMENT WITH SPIRAL SPACER FOR FAST BREEDER REACTORS. Baumann, W.; Casal, V.; Hoffmann, H.; Moeller, R.; Rust, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Apr. 1968. 119p. (In German). (EUR-3694). Dep.

The configuration and design of fast breeder reactor fuel elements with spiral spacers is discussed; design parameters are tabulated; fuel bundle cross sections are shown. Fabrication of the elements is discussed; tolerances are given; thermal expansion effects and allowances are considered. Heat transfer and pressure drop studies for the fuel element are detailed; surface

and configuration effects are analyzed. Coolant mixing in the fuel element coolant channels is discussed. Temperature distributions are calculated for the cladding material. 14 references. (M.L.S.)

11240 USE OF DEPLETED URANIUM FOR THE FUELING OF HEAVY WATER REACTORS. Gruemm, H. (Institut fuer Reaktorenentwicklung der SGAE., Vienna). Nukleonik, 8: 446-8(1966). (In German). (SGAE-RE-4/1966).

A model for use of depleted U from light water reactors as fuel loading for heavy water reactors is given. Materials balance equations are obtained for the mixed system; data for both types of reactors are tabulated. The savings in U is determined for the mixed system. A three reactor system is described, whereby depleted U from a light water reactor is used as fuel for a heavy water reactor, and then, the Pu from both is used in a breeder reactor. (M.L.S.)

11241 FUEL ASSEMBLY FOR NUCLEAR REACTORS. Gumuchian, Andre (to Commissariat a l'Energie Atomique). British Patent 1,139,967. Jan. 15, 1969. Priority date Dec. 5, 1966, France.

REACTOR FUEL ELEMENTS—fast liquid metal-cooled reactor helix-shaped coolant duct in tubular-shaped bundle-arranged pin-type, description of

REACTORS, FAST—fuel assemblies for liquid metal-cooled, description of helix-shaped coolant duct in tubular-shaped bundle-arranged pin-type

REACTORS, LIQUID METAL-COOLED—fuel assemblies for fast description of helix-shaped coolant duct in tubular-shaped bundle-arranged pin-type (D.L.C.)

11242 FUEL ASSEMBLY FOR NUCLEAR REACTORS. Gumuchian, Andre (to Commissariat a l'Energie Atomique). British Patent 1,139,968. Jan. 15, 1969. Priority date Dec. 5, 1966, France.

REACTOR FUEL ELEMENTS—fast liquid metal-cooled reactor tubular-shaped bundle-arranged multiple-chamber pin-type, description of

REACTORS, FAST—fuel elements for liquid metal-cooled, description of tubular-shaped bundle-arranged multiple-chamber pin-type

REACTORS, LIQUID METAL-COOLED—fuel elements for fast, description of tubular-shaped bundle-arranged multiple-chamber pin-type (D.L.C.)

11243 FUEL ASSEMBLIES FOR NUCLEAR REACTORS. Gumuchian, Andre (to Commissariat a l'Energie Atomique). British Patent 1,139,969. Jan. 15, 1969. Priority date Dec 5, 1966, France.

REACTOR FUEL ELEMENTS—assemblies of fast liquid metal-cooled, description of upward-flow-cooled bundle-arranged multiple tubular pin-type

REACTORS, FAST—fuel assemblies for liquid metal-cooled, description of upward-flow-cooled bundle-arranged multiple tubular pin-type

REACTORS, LIQUID METAL-COOLED—fuel assemblies for fast, description of upward-flow-cooled bundle-arranged multiple tubular pin-type (D.C.C.)

11244 STATUS OF FAST BREEDER REACTOR FUEL DEVELOPMENT. OXIDE FUEL. Nakayama, Yasuji (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Genshiryoku Kogyo, 14: No. 8, 19-24(Aug. 1968). (In Japanese).

The present state of development of mixed oxide fuels for fast reactors in Japan is described in the following sections: production of mixed oxide fuels (needs in the development of production technology, and processes of the production); production of nuclear fuel pins; design and construction of fuel assemblies; irradiation tests. (NSA of Japan)

Auxiliary and Emergency Systems

11245 (CONF-680419-, pp 403-21) FUEL HANDLING MECHANISMS FOR LMFBR SYSTEMS. Anderson, D. R. (Atomics International, Canoga Park, Calif.).

Because of its effects on plant availability, fuel handling is the most important system in the LMFBR. Major scheduled outage is for refueling and for no other reason. A semiannual refueling outage of 10-days for a 1000-MW(e) plant would cost $480,000 based on a 2 mill/kwh reserve capacity incremental charge. A one-month decrease in the ex-core fuel inventory holdup time can reduce fuel cycle costs by 0.017 mill/kwh. General requirements for fuel handling mechanisms are identified by examining interfaces with the other reactor plant systems. The impact of fuel handling on containment, core, vessel, fuel management, and decay storage are discussed. The preservation of fuel integrity during handling is emphasized. The technology of refueling systems in existence today is explored in terms of advantages, disadvantages, and the technical basis for future systems. In-vessel vs ex-vessel storage and on-line vs off-line refueling schemes are compared and the economics of in-vessel storage for various refueling intervals is presented. Conclusions are drawn from the LMFBR refueling concepts being considered by the major reactor plant suppliers. The cautious extrapolation of existing technology illustrates the uncertainty in mechanisms that operate in Na. Development and quality assurance procedures for codes and standards are the key elements in achieving successful fuel handling mechanisms for industry use. 8 references. (auth)

11246 INSTRUMENTATION OF NUCLEAR REACTORS. Dale, Walter Bernard; Gill, Robert William Londoros; McCrerie, Alan Ian; Seeley, Thomas Arthur (to United Kingdom Atomic Energy Authority). British Patent 1,139,722. Jan. 15, 1969. Filed Mar. 23, 1965.

A system for the measurement of fuel can temperatures in graphite-moderated gas-cooled reactors by means of thermocouples is described. For convenience, the thermocouple signal is passed through disconnectable contact assemblies located at the top of the fuel element channel. The contact assembly necessitates the use of high purity Al_2O_3 insulators both for sealing the mineral-insulated metal-sheathed thermocouples against the reactor coolant gas and for the insulation of the sliding elements of the contact assembly. In order to minimize deterioration of insulating properties, the insulator is protected by a housing into which a gas supply is directed to keep the insulator clean. Multiple insulators are mounted within a common housing. A number of contacts are provided for cooperation with contacts in a complementary housing, and a number of gas flow passages are provided for directing the gas supply to sweep over the insulators and contacts. The gas supply can be reactor coolant gas, or a clean inert gas such as He or N_2 provided from outside the reactor pressure vessel. (UK)

11247 REACTOR SUBSIDIARY DEVICES. Abe, Shigeyoshi (to Hitachi Ltd.). Japanese Patent 1968-22790. Sept. 25, 1968. Filed Aug. 3, 1966.

The method proposed has the following advantages: simple construction; less chances of breakage; and simple operation. A filter and a water purifier are connected to heat exchangers which connect to a reactor pressure vessel. A pipe from the purifier is connected to the secondary side of at least one heat exchanger. The pipe then connects to the pressure vessel. A bypass with a valve is installed from before the filter to after the purifier. Another bypass with a valve is used over the first heat exchanger. (NSA of Japan)

Operation and Economics

11248 (BNWL-919, pp 4.1-4) FUEL DEVELOPMENT FOR GAS-COOLED REACTOR-HTGR GRAPHITE STUDIES. Nightingale, R. E. (Battelle-Northwest, Richland, Wash.).

The effects of γ-radiation on carbonaceous impurities in quartz and Pyrex ampoules containing graphite, He, and water vapor are analyzed. Quartz ampoules are favored over the Pyrex ampoules due to the high-temperature heating capabilities. Analysis of impurities in the Peach Bottom Power Reactor Unit 1 is presented. (D.C.C.)

11249 (ORNL-tr-1784) PROGRAMS AND ECONOMY OF EUROPEAN FAST REACTORS. Berridge, D. R. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Energ. Nucl. (Paris), 9: 275-8(1967). 12p. Dep. CFSTI.

Programs in western Europe on fast reactor development are examined. Technical and economic factors affecting fast reactor construction and operation are discussed, and estimated timetables for fast reactor installation are presented. (H.D.R.)

11250 MSBR: A STATUS REPORT. Swanson, Einar. Power Eng., 73: 46-7(Jan. 1969).

The basic concept of the molten salt reactor cycle is described. Operation requirements for economic performance of MSBR are discussed. (D.C.C.)

Safety and Siting

11251 (BNWL-433) NUCLEAR SAFETY QUARTERLY REPORT, JANUARY-MARCH 1967 FOR NUCLEAR SAFETY BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. Albaugh, F. W.; Fuquay, J. J.; Harty, H.; Voiland, E. E.; Worlton, D. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1967. Contract AT-(45-1)-1830. 57p. Dep. CFSTI.

ACOUSTIC EMISSION METHOD—use for crack detection in reactor pressure pipe
CHROMIUM ISOTOPES Cr-51—concentration in Columbia River sediments, analysis of
COBALT ISOTOPES Co-60—concentration in Columbia River sediments, analysis of
COLUMBIA RIVER—sedimentation in, analysis of γ-emitting
CONTAINMENT SYSTEMS EXPERIMENT—containment vessel for, leak rate testing of
—spray systems effectiveness in reduction of gas phase fission product concentration in
FILTERS—performance of reactor containment system fission product aerosol, testing of
FISSION PRODUCTS—removal of gaseous, effectiveness of reactor containment filters for
HYDRAZINE—effectiveness of sprays of, for removal of methyl iodide from reactor containment systems
IODINE—removal of fission product aerosols of, effectiveness of reactor containment filters for
MANGANESE ISOTOPES Mn-54—concentration in Columbia River sediments, analysis of
METHANE, IODO—removal of fission product aerosols of, effectiveness of reactor containment spray systems for
PIPES—crack detection in pressure, acoustic emission signal analysis for
RADIOACTIVE WASTE—disposal of gaseous, analysis of underground gas-injection
REACTOR CONTAINMENT STRUCTURES—leakage from, testing for
REACTOR CONTAINMENT SYSTEMS—fission product removal from, effectiveness of spray systems for gaseous
REACTOR SAFETY—coolant blowdown in simulated reactor, Containment Systems Experimental simulation of
—fission product aerosol removal from containment systems, effectiveness of spray systems for
SCANDIUM ISOTOPES Sc-46—concentration in Columbia River sediments, analysis of
ZINC ISOTOPES Zn-65—concentration in Columbia River sediments, analysis of (D.C.C.)

11252 (BNWL-926) NUCLEAR SAFETY QUARTERLY REPORT, AUGUST–OCTOBER 1968, FOR NUCLEAR SAFETY BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1968. Contract AT(45-1)-1830. 132p. Dep. CFSTI.

ACOUSTIC EMISSION METHOD—use for crack detection in reactor pressure pipe
CALCINATION—spray equipment and procedures development for radioactive waste solutions
CESIUM—removal of fission product aerosols of, effectiveness of reactor containment spray system for
CONTAINMENT SYSTEMS EXPERIMENT—coolant blowdown tests in, pressure transients during simulated pressurized-water reactor
—spray systems of effectiveness for reduction of gas phase fission product concentration in
FISSION PRODUCTS—removal of gaseous, effectiveness of reactor containment spray systems for
GLASS—production of phosphate, for fixation of radioactive wastes
IODINE—removal of fission product aerosols of, effectiveness of reactor containment spray system for
METHANE, IODO—removal of fission product aerosols of, effectiveness of reactor containment spray system for
PIPES—crack detection in pressure, acoustic emission signal analysis for
RADIOACTIVE WASTE—fixation by conversion to phosphate glass, evaluation of test runs for
—solidification of solutions of, spray calcination equipment and procedures development for
REACTOR CONTAINMENT SYSTEMS—fission product removal from, effectiveness of spray systems for gaseous
REACTOR SAFETY—coolant blowdown in simulated pressurized-water reactor, pressure transients for
REACTORS, PRESSURIZED-WATER—coolant blowdown in, pressure transients during simulated
STEEL—fracture toughness of ASTM A533, measurement of
TRANSDUCERS—development of acoustic emission analysis high-temperature capacitance
URANIUM—removal of fission product aerosols of, effectiveness of reactor containment spray system for (D.C.C.)

11253 (BNWL-935) WASHOUT OF METHYL IODIDE BY HYDRAZINE SPRAYS. Final Report. Schwendiman, L. C.; Hasty, R. A.; Postma, A. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1968. Contract AT(45-1)-1830. 69p. Dep. CFSTI.

Analysis of the effectiveness and merit of hydrazine for use as a spray additive for washing methyl iodide from containment atmospheres following a reactor accident is determined. Two principal areas were studied: the physiochemical aspects of the hydrazine-water-methyl iodide system, and the washout of methyl iodide with hydrazine solution sprays. Methods and apparatus were developed for measuring the reaction rate of methyl iodide and aqueous solutions of hydrazine. Rate constants were measured for temperatures from 24.6 to 64.7°C and for various hydrazine concentrations. The reaction rate was determined to be second order. The activation energy was calculated to be 20.2 Kcal/mol. Reaction rates with 1,1-dimethylhydrazine monomethyl hydrazine, and some sulfur based compounds were determined for comparative purposes. The reaction rate with hydrazine was found to be essentially independent of OH^- concentration. Various correlating indices were investigated. The nucleophilic character of the reactant and the relative reaction rates in solvents other than water can be used to help predict relative reaction rates. Theory of stagnant droplet and flowing film removal of an airborne gas such as methyl iodide was developed with computer solutions of the droplet removal equations. Input data are partition coefficient, reaction rate, droplet diameter, and exposure time. Experiments in two spray chambers gave washout half-times of methyl iodide which varied with spray rate, concentration of hydrazine, and temperature. The observed washout rate in the vessels used and reactive spray droplet removal theory permitted extrapolation to full-size containment vessels. Results show that the radiation sensitivity of hydrazine outweighs the desirable qualities as a spray additive. (auth)

11254 (CEA-R-3550) SHUTDOWN CHANNELS AND FITTED INTERLOCKS IN ATOMIC REACTORS. Furet, Jacques; Landauer, Claude (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct. 1968. 28p. (In French). Dep.

Tables of data on safety circuits in French critical assemblies, research reactors, and power reactors are presented. Included are: number and type of detectors, range of the shutdown channels, nature of the associated electronics, alarm threshold settings, and fitted interlocks. (H.D.R.)

11255 (DP-1168) QUANTITATIVE ANALYSIS OF REACTOR SAFETY. Arnett, L. M. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Nov. 1968. Contract AT-(07-2)-1. 55p. Dep. CFSTI.

The behavior of the safety mechanisms of a nuclear reactor is modeled, and the probabilities of each incident whose consequences are of safety concern are calculated by either of two computer programs. The model accounts for scheduled inspection and maintenance of all mechanical devices. (auth)

11256 (IDO-17265) ENGINEERING AND TEST BRANCH QUARTERLY TECHNICAL REPORT, APRIL 1–JUNE 30, 1968. Dietz, K. A. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Oct. 1968. Contract AT(10-1)-205. 70p. Dep. CFSTI.

REACTIVITY—measurements in LOFT, effects of fuel pin variation on
REACTOR CONTAINMENT SYSTEMS—pressure-temperature response of, effects of blowdown core cooling and initial heatup on
REACTOR FUEL ELEMENTS—temperature response of, effects of blowdown core cooling and initial heatup on
REACTOR SAFETY—pressure-temperature transients in water cooled power reactors during coolant loss accidents, mathematical model for CONTEMPT-PS program for predicting
REACTOR SAFETY EXPERIMENTS—core for LOFT, use of thermal symmetry to simulate post-blowdown heatup temperature transients in
—fuel pins for LOFT, effects on reactivity of variations in
REACTORS, BOILING—core for, use of thermal symmetry to simulate post-blowdown heatup temperature transients in
REACTORS, POWER—coolant loss accidents in, mathematical model for CONTEMPT-PS program for predicting pressure-temperature history in pressure-suppression containment vessel during
REACTORS, PRESSURIZED-WATER—fuel elements for, parametric studies of temperature response during blowdown core cooling and initial heatup of
—containment system for, parametric studies of pressure-temperature response during coolant loss accidents of
—blowdown calculations for, development of branching and merging flow path equations for BURST

REACTORS, WATER-COOLED—coolant loss accidents in, mathematical model for CONTEMPT-PS program for predicting pressure-temperature history in pressure-suppression containment vessel during
—core for, use of thermal symmetry to simulate post-blowdown heatup temperature transients in (M.L.S.)

11257 (KFK-813) THEORETICAL TREATMENT OF HYPOTHETICAL SEVERE ACCIDENTS ON FAST POWER REACTORS. Braess, D.; Thurnay, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). July 1968. 25p. (In German). (EUR-3971). Dep.

In the design of fast power reactors the safety considerations are governed by the investigation of second excursions. These excursions might occur when there is an assumed failure of the cooling system and, at the same time, a breakdown of all safety devices. Second excursions are mostly studied with the so-called Bethe-Tait-Method. This method is developed further and the effect of doppler feedback and of delayed neutrons is studied. (auth)

11258 A MODEL FOR THE CALCULATION OF FAST POWER EXCURSIONS IN REACTORS WITH CONTINUOUS CHARGE-DISCHARGE FUEL CYCLE. Friedrich, K.; Infuehr, E.; Massimo, L. (Brown Boveri/Krupp, Mannheim, Ger.). Atomkernenergie, 14: 1-4(Jan.-Feb. 1969).

A zero-dimensional program for the kinetics of pebble bed reactors is described. In order to determine the temperature effects on reactivity more accurately than by considering an average fuel element, this program calculates the temperature distribution in a given number of fuel element classes, each class representing a different burn-up stage. The differences in power and temperatures between the models of an average fuel element and several fuel element classes are discussed for some examples which have been calculated using this program. (auth)

11259 LOCAL STRESSES IN SUPPORT-SKIRT OF REACTOR PRESSURE VESSEL DUE TO ASYMMETRIC LOAD. 2. Shimizu, Tasuku; Iwasaki, Tsutomu (Hitachi Ltd., Tokyo). Hitachi Hyoron, 50: No. 8, 1-5(Aug. 1968). (In Japanese).

Studies were made by experiment and calculation on the local stresses occurring at the support skirt when a reactor pressure vessel sustained a non-axis-symmetrical load due to an earthquake. In the experiment, large local stress was found to occur at the joint of the vessel body and the skirt. The result of calculation agreed well with the experiment for a cylindrical shell model other than the support skirt, but it differed considerably for the support skirt to the pressure vessel in the positioning of the skirt. This was probably due to the large effect of ribs on the stress distribution. For the support skirt with ribs, this effect must therefore be considered in the calculation. From the standpoint of stresses, it is preferable for the support skirt to be devoid of the ribs. (NSA of Japan)

11260 THE FLASH-2 METHOD FOR LOSS-OF-COOLANT ANALYSIS. Redfield, J. A.; Murphy, J. H. (Westinghouse Electric Corp., West Mifflin, Pa.). Nucl. Appl., 6: 127-36(Feb. 1969).

A loss-of-coolant analysis method, FLASH, has been tested experimentally and improved. The more versatile FLASH-2 computer program that evolved produces results that agree with classical theory in the case of decompression of pipes and with experiment in the case of blowdown of water-filled tanks. Such agreement increases confidence in FLASH-2 as a rational basis for predicting the consequences of a loss-of-coolant accident. (auth)

11261 SYSTEMATIC SAFETY ASPECTS OF THE PEBBLE BED-HTR. Baust, E. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomwirt., Atomtech., 14: 32-3(Jan. 1969). (In German).

The design features of the Thorium High Temperature Reactor (THTR) are discussed. Safety aspects are described; fuel melting, He stability, prompt temperature coefficient of reactivity, prestressed concrete pressure vessel, and continuous fueling are considered. (M.L.S.)

11262 ASEISMIC DESIGN OF NUCLEAR POWER PLANTS. DEVELOPMENTS OF THESE TEN YEARS. Shibata, Heiki (Tokyo Univ.). Seisan-Kenkyu, 20: No. 8, 6-16(Aug. 1968). (In Japanese).

Various aspects and problems in the aseismic design of nuclear power stations are described chronologically for the past ten years in relation with studies in the Tokyo Univ. IIS in the following: the present state of aseismic design of nuclear power stations; and the course of studies on the aseismic design of structures, machinery, ducts and pipes. (NSA of Japan)

Power Conversion Systems

11263 (CONF-680419-, pp 303-25) COMPONENTS FOR STEAM COOLED REACTORS: REQUIREMENTS AND DEVELOPMENT STATUS. Leitz, F. J.; Rittenmyer, G. J.; Schneider, H. J. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation).

A description of the steam cycle for a steam-cooled fast reactor is presented. A diagram and design parameters for a 50 MW(e) Loeffler cycle power conversion system are presented. 2 references. (D.C.C.)

11264 (CONF-680419-, pp 354-402) SODIUM HEATED STEAM GENERATORS. Kovacic, E. C. (Atomic Power Development Associates, Inc., Detroit, Mich.); McDonald, J. S. (Atomics International, Canoga Park, Calif.); Probert, P. J. (Babcock and Wilcox Co., Barberton Ohio. Boiler Div.).

A report of the available information on the development of sodium heated steam generators in the U. S. is presented. Topics discussed include: repairs to the Enrico Fermi Atomic Power Plant steam generators; design and development of the Atomics International modular steam generator; construction of the Babcock & Wilcox prototype unit; results of the large-leak sodium water reaction tests at Atomics International; and the small-leak sodium water reaction tests at Atomic Power Development Associates, Inc. (auth)

11265 (RCN-98, pp 71-7) STATISTICAL METHODS IN EXPERIMENTAL REACTOR PHYSICS AND SOME OF THEIR APPLICATIONS. Kuznetzov, V. A.; Mogilner, A. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut).

The application of statistical methods to reactor physics calculations is discussed. Use of statistical methods for detailed investigation of reactor spatial effects is analyzed. (M.L.S.)

11266 COMBINED STEAM-HELIUM TURBINE PLANTS FOR GAS COOLED REACTORS. Bammert, Karl (Technische Univ., Hanover). Atomkernenergie, 14: 70-1(Jan.-Feb. 1969). (In German).

Turbine systems for high temperature gas cooled fast breeder reactors are discussed. Diagrams are shown for He turbine and steam turbine plants for a 1000 MW He cooled reactor; temperature-eutropy diagrams are shown. Net efficiency for simple and combined turbine systems is tabulated. A combined steam-He turbine system for a 2000 MW reactor is considered. (M.L.S.)

11267 METHOD OF POWER GENERATION AND THERMAL POWER PLANT FOR THE APPLICATION OF SAID METHOD. Pouderoux, Pierre (to Stein and Roubaix). British Patent 1,140,485. Jan. 22, 1969. Priority date Feb. 3, 1966, France.

HEAT TRANSFER SYSTEMS—power conversion, description of liquid metal-cooled fast power reactor multiple-loop superheat
REACTORS, FAST—power conversion system for liquid metal-cooled power, description of multiple-loop superheat
REACTORS, LIQUID METAL-COOLED—power conversion system for fast power, description of multiple-loop superheat
REACTORS, POWER—power conversion system for liquid metal-cooled fast, description of multiple-loop superheat
REACTORS, SUPERHEATING—power conversion system for liquid-metal cooled, description of multiple-loop (D.C.C.)

Research and Test Reactors

Refer also to abstracts 9639, 9640, 9809, 10254, 10272, 10304, 10907, 10910, 11153, 11154, and 11254.

11268 (AAEC/TM-481) MOATA TRANSFER FUNCTION. Marks, A. P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct. 1968. 17p. Dep.

The zero-power transfer function of the Argonaut-type reactor MOATA has been measured using a digital correlation technique. Analysis of the results yielded a value of 124 μs for the prompt neutron mean lifetime. (auth)

11269 (AEC-tr-6976) RESULTS OF EIGHT YEARS OF OPERATION OF THE BR-5 REACTOR. Leipunskii, A. I.; Kazachkovskii, O. D.; Ovechkin, D. M.; (and others) ([Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut]). Translated from a Russian report. 18p. Dep. CFSTI.

An eight year cumulation of operations experience with the fast liquid Na cooled BR-5 is given. The testing and reliability deter-

minations are summarized. Experience with the oxide fuels is outlined; use of Na as a coolant is discussed. Na technology and primary systems functioning are evaluated. Redesign of the facility, in order to double reactor power and use PuO_2 fuels, is discussed briefly. (M.L.S.)

11270 (AERE-M-2132) A.E.R.E. GENERAL-SERVICE RIGS. Child, J. B. (Atomic Energy Research Establishment, Harwell (England)). Oct. 1968. 7p. Dep. CFSTI. UK.

DIDO and PLUTO reactors are equipped with several types of general-service rigs for the irradiation of encapsulated samples. The rigs listed fall into four main groups: single-tube rigs, movable stem rigs, cakestand rigs and multi-tube rigs. Typical examples of the single and multi-tube rigs are shown. Examples of typical cans and capsules are shown. The maximum allowable heat ratings from the irradiation tubes or specimen capsules are listed (auth)

11271 (ANL-7423) DESIGN AND ANALYSIS OF INSTRUMENTED SUBASSEMBLY SYSTEM FOR EBR-II. Smaardyk, A.; Divona, C. J.; Olp, R. H.; Hutter, E. (Argonne National Lab., Ill.). June 1968. Contract W-31-109-eng-38. 48p. Dep. CFSTI.

The research, design, and development work for the construction of a prototype subassembly for the EBR-2 reactor is described. The subassembly configuration is identical to a standard control rod subassembly. (D.C.C.)

11272 (AWRE-NR/A-1/62) CRITICAL MASS MEASUREMENTS WITH THIN DISCS OF 45.5 PERCENT ENRICHED URANIUM. Dominey, J. R.; Lane, R. C.; Thomas, A. F. (Atomic Weapons Research Establishment, Aldermaston (England)). Mar. 1962. 35p. Dep.

Critical masses of cylinders of 45.5% enriched U have been measured for systems with effective radii of 5.79, 8.46 and 11.05 in. Measurements were made for bare systems and for systems reflected by natural U, graphite, borated graphite, steel and Al. The results obtained gave critical masses in the height/diameter ratio range of 0.08 to 0.63, and these results are correlated by the use of an equal geometric buckling conversion. (auth)

11273 (BNL-13076) PULSED REACTOR APPLICATIONS TO NEUTRON INELASTIC SCATTERING EXPERIMENTS. Beckurts, K. H. (Brookhaven National Lab., Upton, N. Y.); Brugger, R. M. (Idaho Nuclear Corp., Idaho Falls). [1968]. 27p. (CONF-690102-1). Dep. CFSTI.

From Fast Burst Reactor National Topical Meeting, Albuquerque, N. Mex.

The possibilities for using a pulsed reactor as a neutron source for inelastic scattering time-of-flight studies with slow neutrons are reviewed. A rough comparison between steady-state reactors and pulsed reactors for a simple experiment is carried out in some detail, and the implications of the recently introduced method of "statistical chopping" are reviewed. It is concluded that very advanced pulsed reactor systems, yielding short bursts and peak fluxes in the range 10^{16} to 10^{17} cm^{-2} sec^{-1}, could result in considerable progress in the field of inelastic scattering studies. (22 references) (auth)

11274 (BNWL-852) FAST FLUX TEST FACILITY CLOSED LOOP DEVELOPMENT AND TESTING PROGRAM. Kolowith, R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1968. Contract AT(45-1)-1830. 65p. Dep. CFSTI.

Topics discussed concerning the closed loop system test installation include: verification of analytical design; investigation of FTR performance parameters and limited transient effects; demonstration of remote handling and maintenance equipment; testing of closed loop system components; and training of operators and maintenance personnel. (D.C.C.)

11275 (BNWL-872) SURVEY OF REACTOR FACILITIES FOR PRESSURE TUBE IRRADIATION. Ard, P. A.; Heck, E. N.; McJilton, C. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1968. Contract AT(45-1)-1830. 48p. Dep. CFSTI.

A review of available reactor facilities for fast neutron irradiation studies of Zircaloy 2 and Nb-Zr pressure tubes is presented. The reactor facilities described include loops of ETR and ATR. (D.C.C.)

11276 (BNWL-905) BELLOWS SEALS FOR LIQUID METAL SYSTEMS: LITERATURE SEARCH FOR FABRICATION AND OPERATIONAL EXPERIENCE. Aungst, R. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1968. Contract AT(45-1)-1830. 31p. Dep. CFSTI.

The conceptual design of the control system for the Fast Test Reactor (FTR) proposes a bellows seal to isolate the drive mechanism from the Na. The seal separates the pure inert gas surrounding the drive mechanism from the mixture of Na vapor and inert gas covering the 1200°F Na pool in the reactor vessel. Seals of this type have been used in previous liquid metal systems. A search of the literature has been made to determine operating experience and provide specifications for procurement of a metallic bellows seal to meet FTR criteria. 136 references are included. (auth)

11277 (BNWL-909) CONSIDERATIONS ON THE MEDIA FOR DECAY STORAGE OF FUEL ELEMENTS. Winegardner, W. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1968. Contract AT(45-1)-1830. 31p. Dep. CFSTI.

Topics discussed concerning FFTF fuel element storage facilities include: corrosion and compatibility aspects of potential storage mediums and components to be stored; and conceptual design features for storing irradiated driver fuel sections, packaged pins and hardware, and nonroutine and future fuels. (D.C.C.)

11278 (BNWL-914) TYPICAL CHARACTERISTICS OF ADVANCED CORES IN THE DISPERSED FTR. Rothrock, R. B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1968. Contract AT(45-1)-1830. 33p. Dep. CFSTI.

An advanced fuel system for the FTR is discussed. Core design parameters for 400 MW capabilities are presented for PuC-UC composition. A comparison with PuO_2-UO_2 core parameters is made. The fuel pin configuration for a PuC-UC core is described. Effects of fuel pin configurations and compositions on power capabilities are analyzed. The use of BeO pins in the core is described. (D.C.C.)

11279 (BNWL-919, pp 12.1-58) IRRADIATION DAMAGE TO REACTOR METALS. Bement, A. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Operations in the ETR reactor for Cycle g5 and Cycle g6 are described. The effects of thermomechanical treatments on tensile properties of austenitic stainless steels are presented. The effects of neutron radiation on the mechanical properties of Type 304 stainless steel, Hastelloy X, Zircaloy 2, and Nb-Zr are analyzed. Fracture toughness values for specimens of ASTM A533 steel are measured. A fast neutron irradiation program is described. Fracture studies for Zircaloy 2 are discussed. The dislocation-defect interactions that provide changes in mechanical properties of materials in neutron irradiation are analyzed. The effects of stress on irradiation-promoted phase transitions in ZrO_2 are discussed. Corrosion and hydrogen absorption of Zircaloy 2 is evaluated for NH_4OH environment. Stress-rupture tests for tubing of Nb-Zr are described. Cavity distributions in Type 304L stainless steel are described as influenced by fast neutron radiation. Fast neutron radiation effects on the tensile properties of Type 304 stainless steel and Type 316 stainless steel are analyzed. A flow diagram for the manufacturing process and quality control inspection of stainless steel tubing is presented. (36 references are included) (D.C.C.)

11280 (BNWL-SA-2190) DESIGN OF FFTF CLOSED LOOPS. Vogel, M. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 31, 1968. Contract AT(45-1)-1830. 9p. (CONF-681106-10). Dep. CFSTI.

From Conference on Sodium Technology and Large Fast Reactor Design, Argonne, Ill.

Design aspects of the sodium-cooled closed loops for the Fast Flux Test Facility are described. The loop primary system and in-reactor tube designs are illustrated, and the loop testing capabilities and proposed solutions to some of the major design problems are tabulated. (H.D.R.)

11281 (CONF-680419-, pp 437-44) REVIEW OF FBR CORE DESIGN PROBLEM AREAS. Noyes, R. C. (Combustion Engineering, Inc., Windsor, Conn.).

The FBR core design procedures are described. Topics discussed include: fuel cycle costs; flow characteristics in core; and heat transfer. (D.C.C.)

11282 (GEMP-281) NEUTRON LIFETIME MEASUREMENTS ON A TWO-LIFETIME COMPONENT CRITICAL EXPERIMENT BY THE ROSSI-ALPHA TECHNIQUE. Kunze, J. F.; Sims, F. L. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Apr. 6, 1964. Contract AT(40-1)-2847. 22p. Dep. CFSTI.

A two-component theory of neutron lifetime in an assembly consisting of a fast core surrounded by a moderating reflector is applied to the Rossi-alpha method. The results obtained during a series of measurements on the initial 710 Critical Experiment in May of 1963 are compared with the computer predictions of the Carlson S-4 calculations (Program S-X) on the reactor. (auth)

11283 (GEMP-297) 710 CRITICAL EXPERIMENT CORRELATION. Bermanis, H. L.; Henderson, W. B.; Robertson,

C. S. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). June 30, 1964. Contract AT(40-1)-2847. 179p. Dep. CFSTI.

Correlation of calculations with experimental data from the 710 critical experiment is reported. Critical loading is calculated within about 4 percent by both transport and diffusion methods, however the neutron spectra in the core and the radial Be reflector are too soft judging by experimental data of fission rate ratios and neutron lifetime. W and Ta inelastic transfer distributions are postulated to be contributing to the core spectral error, while errors in multigroup Be scatter-transfer cross sections are pointed out as contributing to the reflector spectral error. (auth)

11284 (GEMP-376) 710 BASIC CRITICAL EXPERIMENT SUMMARY DATA REPORT. Kunze, J. F.; Sims, F. L. (General Electric Co., Cincinnati, Ohio. Atomic Products Div.). Dec. 8, 1965. Contract AT(40-1)-2847. 267p. Dep. CFSTI.

A summary of the experiments associated with the basic critical experiment configuration related to the 710 Reactor Experiment Program is reported. It includes descriptions of the techniques used and the data obtained, the primary function of which was in the application to the analysis-to-experiment correlation. The major experimental areas included initial loading, neutron lifetime, fission ratios, reactivity coefficients, reflector control methods, and power distribution measurements. (auth)

11285 (IN-1258) STANDARD MTR FUEL LOADING PROCEDURE. Wachs, G. K. (Idaho Nuclear Corp., Idaho Falls). Dec. 1968. Contract AT(10-1)-1230. 26p. Dep. CFSTI.

Presented is a detailed description of the procedures used to calculate MTR fuel loadings. The criteria supercedes that set forth in document IDO-16661. The procedures have been revised to reflect the current practice and limitations now adhered to by the responsible Nuclear and Chemical Technology representative in the Reactor Physics and Engineering Section. In addition, the procedures incorporate present methods of maintaining fuel loading records and subsequent transfer of information to personnel associated with MTR operations. No attempt has been made to include theoretical background or justification for the procedures; however, references are cited from which this information may be obtained. (auth)

11286 (JUL-546-RE) RESULTS OF THE START UP EXPERIMENTS OF THE REACTOR FRJ-1 AFTER REMODELING. Bormann, H. J.; Meister, G.; Muench, E. (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Forschungsreaktoren). July 1968. 80p. (In German). Dep.

Low power startup physics measurements in the FRJ-1 after remodeling are described. The reactor is detailed; core configuration, reactivity balance, test facilities, and instrumentation are described. Coolant throughput is described; results of measurements are given. Critical mass measurements are described; results of reactivity measurements are analysed. Rod drop measurements are described; results are shown graphically. Neutron flux measurements are discussed; thermal flux profiles are shown. 15 references. (M.L.S.)

11287 (KAPL-M-6910) THE KAPL-76 EXPERIMENT TO DETERMINE FISSIONABLE CONTAMINATION AT ECF. Zeltmann, E. W.; Gray, R. G. (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 26, 1968. Contract W-31-109-eng-52. 37p. Dep. CFSTI.

Tests have been performed to determine whether fissionable contamination will be deposited on the coupons if TP-126 corrosion coupons are carefully handled in the Expended Core Facility, ECF. Sixteen Zircaloy coupons were involved in this experiment. Of all 16 tested, only one had any significant contamination above background. It is our belief that this coupon did not pick up this contamination from the ECF but rather from an Al spacer which was adjacent to it. It has been inferred that TP-126 corrosion coupons may be handled identically at ECF without becoming contaminated with fissionable material. (auth)

11288 (NP-17728) THE ANGLO-BELGIAN SMALL POWER REACTOR DEVELOPMENT PROGRAMME. (Societe Anglo-Belge Vulcain, Brussels). [nd]. 16p. Dep.

The BR3/Vulcain development program in the BR3 reactor is described. (D.C.C.)

11289 (ORNL-4025) THE INTERMEDIATE POTASSIUM SYSTEM: A RANKINE-CYCLE TEST FACILITY. Yarosh, M. M.; Gnadt, P. A. (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 177p. Dep. CFSTI.

A comprehensive description of the design, operation, and analysis of a single-loop boiling-K Rankine-cycle system is presented. The system is designed to be a 36% power mock-up of the Medium-Power Reactor Experiment, with electrically heated rods used to simulate the fuel elements of the reactor. A K-vapor turbine driving a centrifugal pump provides the feed to the boiler, and a valve is used as an adjustable orifice to simulate the turbine of a turbine-generator. The vapor is condensed in a tapered-tube space-type radiator from which the heat is transmitted by thermal radiation to the inner wall of a double-walled compartment. Air is circulated between the walls. The stability and control characteristics of the system are investigated over a power range from zero to 335 kW. (auth)

11290 (ORNL-TM-2437) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT, JULY-SEPTEMBER, 1968. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn.). 32p. Dep. CFSTI.

Operations during July to September 1968 are described. A description of the shutdowns during the quarter is presented. Progress on the control-plate-bearing problem is described. Maintenance requirements are listed. Exhaust filters are rated for efficiency. Water condition monitorings are also listed. Design changes are described. (D.C.C.)

11291 (RCN-98, pp 79-89) REVIEW OF REACTOR NOISE INSTRUMENTATION AND EXPERIMENTS AT R.C.N., PETTEN. Dragt, J. B. (Reactor Centrum Nederland, Petten).

A review is given of the reactor noise work performed in the Reactor Center at Petten. This review contains: a description of the instrumentation for measurements with ionization chambers and with neutron counters, using digital techniques throughout; the history of the experiments; and a complete list of the publications that have arisen from this noise work. (15 references) (auth)

11292 (RCN-98, pp 181-218) EXPERIMENTAL STUDY OF DIFFERENT TECHNIQUES FOR ANALYSING REACTOR NOISE MEASURED BY A NEUTRON COUNTER. Tuerkcan, Erdinc; Dragt, Jan B. (Reactor Centrum Nederland, Petten).

Reactor noise measurements using experimental techniques are discussed. Experiments concerning seven different techniques are described: determination of Feynman's variance-to-mean ratio; Bennet's delta variance; the autocorrelation function; a special third order moment; and the probabilities for zero, one, or an even number of counts. Data from these experiments are fitted to theoretical expressions by the least squares method. The techniques are compared. (15 references) (M.L.S.)

11293 (RCN-98, pp 219-28) COMPARISON OF NEUTRON LIFETIME MEASUREMENT RESULTS MADE BY STATISTICAL AND 1/v-METHOD. Mogilner, A. I.; Krivelev, G. P.; Steclovsky, V. M.; Shvetzov, D. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut).

Prompt neutron lifetime measurement results are presented. The measurements were made by statistical (frequency) and "1/v-type absorber" methods for three uranium-beryllium assemblies. The cores of the assemblies had the same composition; one of the assemblies had a steel reflector; two others had beryllium reflectors of different thicknesses. The measurement results were compared with multigroup calculations in the diffusion approximation. It was found that even for such a complicated system as a beryllium reflected reactor the point model can be applied. The "1/v-type absorber" method of measurements needs a lot of time for experiments; the large gradient of neutron flux at the core–reflector boundary makes the integrating procedure of small reactivity effects all over the reactor volume difficult. Disagreement between the calculational and statistical method from one side, and the "1/v-type absorber" method from another, observed for one of the assemblies, can be explained by this reason. (auth)

11294 (RCN-98, pp 229-38) MEASUREMENT OF ABSOLUTE REACTOR POWER AND EFFECTIVE FRACTION OF DELAYED NEUTRON. Mogilner, A. I.; Krivelev, L. P.; Morosov, S. A.; Shvetzov, D. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut).

Results of measurement of absolute reactor power are presented. The measurements of absolute reactor power, which were carried out for different assemblies of the PF-4 reactor with the help of statistical and non-statistical methods, are described. During the power spectral density measurements the square detection was substituted by a linear one. The validity of this operation is given. Both statistical and non-statistical reactor power measurement methods have allowed to determine the quantity β_{eff} in two experiments. The measurement results are compared with the calculation and with independent measurements made for an assembly. (9 references) (M.L.S.)

11295 (RCN-98, pp 239-77) PRELIMINARY RESULTS OF THE NOISE MEASUREMENTS AND THE CALCULATIONS OF THE PUK CORE IN KRITO. Tuerkcan, Erdinc (Reactor Centrum Nederland, Petten).

A preliminary study of PUK clean core in KRITO facility has been carried out with existing nuclear codes. One and two dimensional four energy groups criticality calculations have been performed. The delayed neutron fraction is calculated with the spectrum method, neglecting all space effects. Neutron lifetime calculations have been done by means of applying a 1/v perturbation to the criticality calculations. The detector efficiency in the center of the core is calculated by integrating the thermal group fluxes over the detector position. The reactor noise experiments have been done by means of the current method for the critical reactor and subcritical measurements have been made with neutron counters. The prompt neutron decay constant and a quantity related to detector efficiency are obtained for many water levels, corresponding to subcriticalities down to −16 dollars with seven different analyzing techniques. The calculated and the measured reactor parameters are compared. (10 references) (auth)

11296 (RCN-98, pp 279-90) COHERENT METHOD OF SUBCRITICALITY MEASUREMENT. Mogilner, A. I.; Ariskin, N. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut).

The known measuring methods for significant negative reactivities, both statistical and dynamic, have large systematic errors caused by the contribution of higher modes into the main neutron distribution. In the statistical methods of negative reactivity measurements the same effect causes a change of the detector efficiency, in addition to the change of the signal depending on the reactivity. All this leads to the change in correlation between useful and "white" components in spectral density of the chamber noise. The statistical methods have less systematic errors when subcriticality measurements are carried out. The coherent method was derived to provide small systematic errors. An analyzer was made which has been investigated during a long-term test on the PF-4 reactor. The results of the experiments are described. (auth)

11297 (RCN-98, pp 339-58) ANALYSIS OF REACTOR NOISE MEASURED IN TWO WEAKLY COUPLED REACTOR CORES. Dragt, J. B. (Reactor Centrum Nederland, Petten).

By determining the correlation between the fluctuations in the signals of two neutron detectors in two different regions of a reactor, information can be obtained on the neutronic coupling between these regions. An outline is given of the theory for the case of a reactor composed of two loosely coupled cores, using the Baldwin model. By comparing the cross-correlation function of the outputs of two ionization chambers near each core, with the cross-correlation function for two detectors in the same core, the coupling coefficient can be found. The experiment has been performed with the Low Flux Reactor at Petten, loaded with a two-slab core, and with properly positioned ionization chambers. (9 references) (auth)

11298 (RCN-98, pp 359-79) NOISE ANALYSIS OF A NEAR CRITICAL HOMOGENEOUS CIRCULATING FUEL REACTOR. Kempkes, A. (Keuring van Electrotechnische Materialen, N. V., Arnhem (Netherlands)).

Neutron flux variations in a homogeneous near-critical assembly are analyzed by correlation techniques. The measurements and measuring system are described. Low frequency noise measurements are detailed; data are shown graphically. High frequency noise measurements are discussed; results are given. (M.L.S.)

11299 (RCN-98, pp 381-95) DYNAMIC MEASUREMENTS IN NUCLEAR PLANTS PERFORMED ON DIGITAL COMPUTER BY STATISTICAL METHODS. Konstantinov, L. V.; Efanov, A. I.; Seliverstov, B. N.; Gavrilov, P. A.; Bykov, Yu. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow).

Statistical investigations of on-line methods to determine reactor dynamic characteristics are still limited to separate experimental investigations. This is mostly due to difficulties in processing experimental data. An attempt to obtain the continuous processing of statistical data using a digital computer is described. Therefore a special attention was paid to information processing, measuring time required, autocorrelation function power spectral measurements, and optimum flattening filter under cut-off conditions of correlation functions. Experiments were performed on a pool-type reactor and a rig, simulating the thermal and physical conditions of a boiling tube-type reactor. Random signal information was analyzed on "BESM-ZM" digital computer using an on-line processing scheme with a card-type data storage. Transfer functions in the frequency range of 0.1 to 50 cps, the value of $1/\beta_{eff}$ and the detector efficiency were obtained from in-pile detector current noise analysis. Considerable changes in power spectral density were observed under boiling simulating conditions when coolant-induced mechanical vibration takes place in the core. (auth)

11300 (RCN-98, pp 427-37) CONTROL OF REACTOR POWER LEVEL WITH STATISTICAL DISCRIMINATION AGAINST GAMMA RADIATION. Mogilner, A. I.; Morosov, S. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut).

Reactor power level determination method using neutron current ionization chambers is described. This method has several advantages over the mean-current method, such as excellent discrimination against gamma radiation and relative freedom from the effects of cable leakage. In this method the reactor power level is measured by the power spectral density value of neutron detector current fluctuations. In the presence of γ radiation the value of power spectral density current fluctuation consists of two components. Since both components depend on the square of the corresponding charges one can choose a neutron detector of which the contribution of γ component would be negligible. This method was tried on the BR-5 experimental power reactor. It was discovered that the proportionality between the reactor power level and the value of power spectral density current fluctuation took place in a wider region than that of the same chamber operated in the mean-current mode. The results of measurements of the relative discrimination coefficients for BF_3 ionization and fission chambers are listed. The requirements for neutron detectors are discussed. A circuit based on this method is presented. (8 references) (auth)

11301 (RCN-98, pp 493-521) SURVEY OF EXPERIMENTAL RESULTS FOR LATTICE CHARACTERISTICS DETERMINATION BY PULSED NEUTRON TECHNIQUE. Delrue, R.; Debrue, J.; Haubert, N.; Mewissen, W.; Stievenart, M. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). Societe Belge pour l'Industrie Nucleaire, Brussels).

Within the frame of the study of plutonium recycling in light water moderated reactors, it is of interest, because of the scarcity of plutonium, to determine the characteristics of lattices by measurements on far subcritical assemblies. The possibilities of the pulsed neutron and source jerk techniques were experimentally investigated on subcritical assemblies moderated and reflected with light water and made of UO_2 fuel pins enriched to 5% in U-235. The water to fuel ratio W/UO_2 of the various lattices ranged from 2.63 to 9.35 and the reactivity from 0.7 to 0.98 which represents about 50 to 90% of the critical mass. The problems inherent in the determination of the critical mass, prompt neutron lifetime, M^2, and k_∞ are discussed. (auth)

11302 (RCN-98, pp 579-600) AN EXPERIMENTAL STUDY OF THE REFLECTOR EFFECTS IN PULSED NEUTRON EXPERIMENTS. Oei, T. D. (Reactor Centrum Nederland, Petten).

The pulsed neutron technique is applied to determine the reactivity of a sub-critical heavily reflected system. The extrapolated-area method is used to evaluate the reactivity from the data. The place-dependent values of the reactivity, with respect to the detector location, are interpreted in terms of a difference in shape between the prompt neutron submode and the delayed neutron submodes. (auth)

11303 CRITICAL EXPERIMENTS FOR THE REPETITIVELY PULSED REACTOR SORA. Kistner, G.; Mihalczo, J. T. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 35: 27-44(Jan. 1969).

A series of static critical experiments has been performed on an accurate mockup of the SORA Reactor. SORA is proposed NaK cooled, repetitively pulsed fast reactor which would be used as a high-intensity neutron source for time-of-flight experiments. The reactivity of this reactor is varied by a movable reflector. Those parameters which are related to the kinetics of the reactor have been investigated thoroughly in the critical experiments. They are measured for both Be and Fe reflectors of several sizes and for various core and fixed reflector configurations. The total reactivity of the movable reflectors is determined. The reactivity of movable reflector as a function of its position is shown to have a parabolic dependence on position. The prompt-neutron time decay is measured. Slow decay constant measurements are described. The critical mass for the various experiments is given. Using space-independent neutron kinetics with one delayed-neutron group, it is shown that the assembly will produce 100 pulses/sec ~50-μsec wide at half-maximum power with a peak-to-average power ratio of ~180. (auth)

11304 IMPROVEMENT TO A RESEARCH REACTOR. Sawai, Sadamu (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-21275, Sept. 6, 1968. Filed Jan. 22, 1965.

Improvements to a horizontal experimental hole and its plug in a research reactor are proposed. The advantages obtained are as follows: easy centering of hole and plug when inserting and

withdrawing a plug; prevention of the inclination and rotation of a plug in the same operation; and keeping constantly horizontal a plug. The experimental hole and its plug are divided in three shapes: the top part is round; the middle part is round with a larger diameter; and the last part is square with larger four sides than the preceding diameter. The center of gravity is in the last "square" part of the plug. An axial guide groove is cut on the bottom surface of the last part of the plug, and the corresponding axial ridge is made on the bottom surface of the experimental hole. A device is installed at the outmost point of the guide groove for emitting a light in the same axial direction. (NSA of Japan)

11305 THE GERMAN–FRENCH HIGH FLUX REACTOR IN GRENOBLE. Chatoux, J.; Eisermann, W. Atomwirt., Atomtech., 14: 25-31(Jan, 1969). (In German).

A detailed description of the Franco-German High Flux Reactor is given. Design data are tabulated for core, fuel, coolant flow, and thermodynamics. Experiment facilities are described; their locations are shown. Instrumentation, fuel elements and fuel handling, cooling circuits, the reactor building and ventilation systems, and reactor safety are discussed. (M.L.S.)

11306 JMTR AND OTHER MTRS. Yoshino, Fujio (Japan Atomic Industrial Forum, Inc., Tokyo). Genshiryoku Chosa Jiho, No. 16, 1-27(June 1968). (In Japanese).

Japan Materials Testing Reactor (JMTR) of the light-water cooled and moderated tank type with thermal output 50 MW went critical in March 1968. The purpose of the reactor is for the domestic development of power reactors. Descriptions of the JMTR are given in the following: irradiation tests and their procedure; the materials testing reactor; MTRs in oversea countries and their utilization; JMTR (installation in the JAERI site, and its domestic construction); operation program of JMTR; hopes for JMTR; future problems associated with JMTR (system for the utilization and irradiation charges). (NSA of Japan)

11307 EXPERIMENTAL STUDIES ON THERMAL REACTOR PHYSICS. Wajima, Tsunetaka; Kikuchi, Hiroshi (Hitachi Ltd., Tokyo). Hitachi Hyoron, 50: No. 7, 71-5(July 1968). (In Japanese).

With the critical experiment facility (OCF) reactor-physics experiments have been performed mainly on BWR-type reactors. The experiments and types of measurements performed are described. (NSA of Japan)

Rocket and Space Reactors

11308 (CONF-680419–, pp 41-60) FAST REACTOR SYSTEMS FOR SPACE POWER. Johnson, Carl E. (Atomic Energy Commission, Washington, D. C.).

Tens-of-kilowatts of electric power will be needed in space in the 1970's and hundreds-of-kilowatts in the 1980's. The Atomic Energy Commissions' reactor space power development program to meet these needs emphasizes three reactor concepts: the ZrH thermal reactor for use with thermoelectric or dynamic conversion for the tens-of-kilowatts range in the 1970's, and the thermionic and advanced liquid metal cooled reactors for use with a variety of power conversion systems by 1980. The development objectives of the space power reactor program are discussed, and an irradiation capsule and a liquid metal corrosion capsule which might be useful in other fast reactor projects are described. (auth)

11309 (GA–9046) REACTOR REQUIREMENTS FOR FIRST GENERATION THERMIONIC NUCLEAR ELECTRIC PROPULSION. Ingber, J. F.; Higdon, D. T. (Gulf General Atomic, Inc., San Diego, Calif.). Nov. 1, 1968. Contract AT(04-3)-167. 33p. Dep. CFSTI.

The lifetime and reactor power level requirements for first generation unmanned nuclear electric propulsion systems are investigated. A Titan III F/Centaur launch vehicle coupled with a 50 to 100 kW(e) thermionic nuclear electric propulsion system was selected as a representative configuration for planetary missions. Relevant mission-related technology constraints are considered in detail, and the performance capabilities of such a system are described. (H.D.R.)

11310 (NAA-SR-Memo-11373(Add.1)) SNAP 8 DEVELOPMENTAL REACTOR (S8DR) SAFETY ANALYSIS REPORT. ADDENDUM 1. Roecker, John H. (Atomics International, Canoga Park, Calif.). Aug. 10, 1968. Contract AT(04-3)-701. 116p. Dep. CFSTI.

Topics discussed include: containment; site; reactor control drums and component testing; reactor coolant system stress analysis; instrumentation, control, and electrical systems; and safety analysis. (D.C.C.)

11311 ROVER NUCLEAR ROCKET PROGRAM. Spence, Roderick W. (Los Alamos Scientific Lab., N. Mex.). Science, 160: 953-9(May 31, 1968). (LA-DC-9400).

The development of U.S. rocket reactors is reviewed. A description of the ROVER program is presented. (D.C.C.)

11312 NUCLEAR PROPULSION FOR SPACE VEHICLES. Cooper, R. S. (McDonnell Douglas Corp., Richland, Wash.). Annu. Rev. Nucl. Sci., 18: 203-28(1968).

The performance of nuclear powered space vehicles is analyzed. Rocket reactor types and characteristics are listed; materials used for rocket reactor construction are described. Essential aspects of engine design are summarized. The application of fluidized-bed, liquid-core, and gas-core reactors to rocket propulsion is considered. 83 references. (M.L.S.)

11313 CAVITY REACTOR CRITICAL EXPERIMENTS. Kunze, J. F.; Pincock, G. D.; Hyland, R. E. (General Electric Co., Idaho Falls, Idaho). Nucl. Appl., 6: 104-15(Feb. 1969).

The cavity reactor concept consists of a core, generally of dilute fuel, surrounded by a moderating reflector. This concept has long been considered as a means of attaining very high temperatures in a gaseous core, since the fuel need not be in contact with structural material. A number of critical experiments have been performed on configurations of different core size and shape, with different structural material thicknesses between the cavity and reflector, with different coolant densities surrounding the core, and with various other alterations. The principal purpose was to evaluate the effects of engineering design variables for a cavity propulsion reactor concept. Experiments reveal that a power reactor with the required structure and a cavity size 182.9 cm (6 ft) diameter by 121.9 cm (4 ft) long can be expected to have a critical core loading of between 20 and 30 kg of ^{235}U. (auth)

11314 NUCLEAR REACTORS FOR POWER SUPPLY IN SPACE. Groll, M.; Hoecker, K. H. (Univ., Stuttgart). Kerntechnik, 10: 607-17(Nov. 1968). (In German and English).

A systematic survey on nuclear space power plants with reactors as heat sources is given. The different possibilities of integration of energy converters with the reactor are discussed. The development and the state of art of these power plants are described. Some types of power plants are discussed. (auth)

11315 ENERGY CONVERTERS FOR NUCLEAR POWER PLANTS ON BOARD SATELLITES. Knoernschild, E. (Deutsche Versuchsanstalt fuer Luft- und Raumfahrt e. V., Stuttgart). Kerntechnik, 10: 618-25(Nov. 1968). (In German and English).

The power requirements of satellites within the next 20 years are likely to require nuclear energy sources. Several processes for converting the heat of nuclear reactions into electric energy are currently being considered. The Rankine and the Brayton cycles require rotating machinery for generating electromechanical power. This may be replaced by a magneto-hydrodynamic energy converter. Thermionic converters, particularly of the in-core type, permit a very compact low weight design. Thermoelectric converters have the simplest design but are considerably heavier and less efficient than the other conversion systems. (auth)

11316 NUCLEAR-ELECTRIC ROCKETS. Loeb, H. (Univ., Giessen, Ger.). Kerntechnik, 10: 626-38(Nov. 1968). (In German and English).

The performance of chemical rockets, exclusively used up to now, is inherently limited. As all the performance-governing thrustor parameters depend on the energy-generating process, nuclear propulsion is obviously superior. The most advantageous way of using nuclear energy is to convert it into electric energy, and to accelerate the propellant by electrothermal, electromagnetic, or electrostatic means. Nuclear-electric rockets attain high velocities and have high payload capacities, but can produce only low thrust-to-weight ratios. They can be used for attitude control of spacecraft, for satellite maneuvers and as drives for scientific probes and for manned space vehicles. (auth)

11317 INCORE THERMIONIC REACTOR FOR ENERGY SUPPLIES FOR SPACE VEHICLES. Andrae, H.; Budnick, D.; Gross, F.; Jahns, W.; Janner, K.; Jester, A. (Brown, Boveri and Cie AG, Mannheim, Ger. INTERATOM, Bensberg, Ger. Siemens AG, Erlangen, Ger.). Raumfahrtforschung, 12: 207-10 (Oct.-Dec. 1968). (In German).

The core and fuel element systems for an in-core thermionic reactor are described; operating conditions are given. Electric power output is shown as a function of thermionic zone thermal power and total specific mass. 12 references. (M.L.S.)

11318 RESULTS OF STUDIES ON THERMIONIC REACTOR SYSTEMS. Pruschek, R.; Dagbjartsson, S.; Emendoerfer, D.; Groll, M.; Haug, W.; Roehrborn, B.; Unger, H.; Wolf, E. (Univ.,

Stuttgart). Raumfahrtforschung, 12: 169-79(Oct.-Dec. 1968). (In German).

The results of various studies on five different thermionic reactor systems are reported. Information is given on characteristic data of these devices such as the amount of fissile material, power output, specific power, mass of components, total mass, etc. Problems of power flattening, long time behavior, integration of converters to the nuclear heat source as well as specific design features of the following types of thermionic reactors are discussed: (1) Thermal incore thermionic reactor (TRIKT), (2) thermal double diode thermionic reactor (DD-TR), (3) fast incore thermionic reactor (SRIKT), (4) fast heat pipe thermionic reactor (WR-TR), (5) fast thermionic reactor, emitter heated by heat radiation (SRAKT-WR). Among the concepts considered the moderated incore thermionic reactor system (TRIKT) is the most attractive within a few tens to a few hundred kW(e). In the lower power range the "Teilthermionikreaktor" (ITR) seems reasonable. (auth)

Process Heat and Desalination Reactors

11319 (JUL-554-RG) SEVERAL PROBLEMS OF COAL DISTILLATION WITH HIGH TEMPERATURE NUCLEAR REACTOR HEAT. Kugeler, K.; Bhattacharyya, A. T. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Aug. 1968. 32p. (In German). Dep.

Use of the 1200°C He effluent from a high temperature gas cooled reactor for decomposition of soft coal is discussed. Heat balance equations for the reaction are derived. Percent of CO, CO_2, and H_2 produced is tabulated as a function of temperature. Mass and energy balances are given. Use of a methanol bath for purification of the synthesised gases is described. The industrial complex resulting from this reactor application is described; a typical interaction diagram is shown. Economics are considered. (M.L.S.)

Marine and Portable Power Reactors

11320 ECONOMICS OF NUCLEAR POWERED MERCHANT SHIPS IN EURATOM'S EVALUATION. Pawlikiewicz, J. (Inst. of Nuclear Research, Warsaw). PTJ, 10: 391-402(1966). (In Polish).

The evaluation of the economic composition between nuclear and conventional powered merchant ships is presented. A method is given to compare economics of nuclear and conventional ship systems. (auth)(NSA of Poland)

11321 VICKERS NUCLEAR POWERED CONTAINER SHIP. Gaunt, I. A. B.; Wilkinson, G. R. Barrow-in Furness, Eng., Vickers Ltd., 1968. 31p.

The principles of containerization and some of the advantages in the application of nuclear power to a container ship are outlined. The design standards, nuclear radiation aspects, accidents, and safety considerations are briefly discussed. The proposed design, which is described in detail, is based on a speed of 24 knots, 40,000 shp, and 40,000 tons displacement. An economic comparison is made with a conventional ship with the same basic parameters. A PWR of the burnable poison reactor type with integral heat exchangers was selected. The ship layout and operation are considered. It is concluded that the increasing size and speed of container ships in the future will prove the advantages of nuclear power. (UK)

11322 SUDOVYE YADERNYE REAKTORY. (Marine Nuclear Reactors). Aleshin, V. S.; Kuznetsov, N. M.; Sarkisov, A. A. Leningrad, Izdatel'stvo Sudostroenie, 1968. 492p.

A brief review is given of the nuclear physics, classifications, theory, heat-exchange mechanics, control systems, construction, and design of nuclear maritime reactors. Concepts of biological protection and shielding are also discussed. The boon can be used as a handboon for engineers designing and operating nuclear power plants. 104 references are included. (R.V.J.)

11323 NUCLEAR REACTORS. Ashcroft, David John; Timbs, Arthur Edwards; Blake, Gordon; Brocklebank, Richard Bennett; Rigg, Shepherd (to United Kingdom Atomic Energy Authority). British Patent 1,139,406. Jan. 8, 1969. Filed Oct. 14, 1966.

A so-called integral reactor suitable for marine application is described. It is cooled and moderated by the same pressurized fluid. The pressure vessel is in three parts: a major cup-shaped body, a smaller top closure, and an annular ring sealed between the top closure and the body. The core of the reactor is supported by a grid within the pressure vessel from the ring. The ring is penetrated by connections to heat exchangers. The heat exchangers are located within the pressure vessel. As an example of the compactness of such a reactor, a 70 MW (thermal) pressurized water reactor can be accommodated in a 20 ft diameter cylindrical space, 24 feet high, which accommodates all accessories such as circulator and control rod drives. (UK)

Reactor Theory

Refer also to abstracts 10923 and 10925.

11324 (KAPL-M-6937) DECAYWT: A PROGRAM FOR WEIGHTED RESPONSES TO DECAY AND ABSORPTION COUPLED NUCLEAR CHAINS. Sherman, D. C. (Knolls Atomic Power Lab., Schenectady, N. Y.). July 17, 1968. Contract W-31-109-eng-52. 21p. Dep. CFSTI.

DECAYWT, a program for the CDC6600 computer, will analyze the time behavior of one to three member coupled nuclear isotopic chains excited in response to a reactor power history. The results are summed with any assigned weighting factors to yield net effects such as reactivity or photoneutron source. The mathematical formulism is provided in the program. Selection of all units, chain parameters, coupling by neutron capture or by radioactive decay, and degree of coupling is left to the user. Each set of chains is limited to no more than 12 nuclides, however the power history can be recycled with new sets to produce accumulative effects due to any number of chains. Approximate running time is 0.0020 sec per nuclide per time increment. Input and output formats are shown; a sample problem is included. (auth)

11325 (KAPL-M-6945) STOCHASTIC KINETIC THEORY FOR A SPACE- AND ENERGY-DEPENDENT ZERO POWER NUCLEAR REACTOR MODEL. Stacey, Weston M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 13, 1968. Contract W-31-109-eng-52. 31p. Dep. CFSTI.

A stochastic kinetic theory for space and energy-dependent, zero power, nuclear reactor models is constructed from a last collision probability argument. The space and energy domains are partitioned into discrete cells. Equations are developed for the probabilities for transitions among the possible states of the reactor, and an equation is obtained for the probability generating function for these transition probabilities. Equations for the mean values, variances, covariances, and correlation functions of the neutron and precursor distributions are derived. The stochastic distributions of neutrons and precursors are found to be space- and energy-dependent in subcritical reactors, but to attain a space- and energy-independent asymptotic form in supercritical reactors. The asymptotic distribution in a supercritical reactor is identical for the neutron and precursor distributions, and depends upon the manner in which the reactor is made supercritical. A method for applying the theory to low source startup calculations is suggested. The influence of spatial stochastic effects upon such calculations is demonstrated. 29 references. (auth)

11326 (KAPL-M-7030) SOME MATHEMATICAL PROPERTIES OF THE FINITE-DIFFERENCE REPRESENTATION OF THE MULTIGROUP KINETICS EQUATIONS. Stacey, Weston M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). July 1968. Contract W-31-109-eng-52. 12p. Dep. CFSTI.

The matrix of coefficients which arises in the multigroup finite-difference representation of the reactor kinetics equations is shown to be real, essentially non-negative, and under certain conditions, irreducible. Such a matrix has a unique positive eigenvector with a real simple eigenvalue greater than the real part of any other eigenvalue of the matrix. The values of the delayed neutron decay constant are shown to be excluded from the eigenvalue spectrum of this matrix. For the case of one energy group, the matrix can be shown to be a kinetics matrix, the extensive properties of which have previously been worked out. 7 references. (auth)

11327 (LA-3992) AN APPLICATION OF THE LAGRANGIAN FUNCTIONAL TO COLLAPSING REACTOR CROSS SECTIONS. Philbin, Jeffrey S.; Carmichael, Byron M. (Los Alamos Scientific Lab., N. Mex.). Sept. 1967. Contract W-7405-eng-36. 15p. Dep. CFSTI.

The characteristic Lagrangian functional for the infinite-medium transport equation has been used to derive a complete set of collapsing formulas for broad-group cross sections. These formulas include adjoint flux weighting but reduce to regular flux weighting formulas when the adjoint spectrum is constant. The collapsed cross sections were used to generate broad group regular and adjoint fluxes, which agreed very well with the values

predicted by the initial fine group spectra. This formulation also ensures the preservation of the eigenvalue. (auth)

11328 (RCN-98) STATISTICAL METHODS IN EXPERIMENTAL REACTOR KINETICS, AND RELATED TECHNIQUES. Proceedings of a Symposium Held at Petten, December 12-19, 1967. (Reactor Centrum Nederland, [Petten]). July 1968. 609p. (CONF-671216).

Separate abstracts are prepared for each of the 30 papers presented. (C.E.S.)

For abstracts of individual papers see: 9700, 9792, 9793, 11124, 11181-11185, 11265, 11291-11302, 11329-11334, 11346, and 11347.

11329 (RCN-98, pp 27-39) APPROXIMATE SOLUTION OF THE POINT REACTOR KINETIC EQUATIONS USING A ONE DELAYED NEUTRON GROUP MODEL FOR A GAUSSIAN WHITE NOISE REACTIVITY INPUT. Dutre, W. L. (Louvain Univ. (Belgium)).

Statistical methods are used for determining the kinetic parameters from point reactor kinetics equations; autocorrelation and spectral density functions are calculated. Nonlinear correction terms to the autocorrelation time and high frequency break point are obtained. (M.L.S.)

11330 (RCN-98, pp 41-61) MULTIDIMENSIONAL NEUTRON FLUCTUATIONS IN THE NUCLEAR REACTOR. Bulavin, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii).

The theory of the stochastic process of neutron multiplication is used in the case of multidimensional neutron fluctuations. The most general method of analytical determination of the law of probability codistribution for the system of an arbitrary finite number of random values is described on the basis of the one-velocity diffusion model. The exact equations for generating functions of codistributions of probabilities of the random values mentioned above are obtained. These equations allow the determination of simple characteristics of random values and simple and mixed moments of higher order which are necessary for proper interpretation of the experimental data and analysis of statistical experimental errors. (auth)

11331 (RCN-98, pp 63-70) THE PRACTICAL USE OF THE p-METHOD AND THE NUMERICAL CALCULATION OF THE PROBABILITY DISTRIBUTION OF NEUTRON COUNTS. Tuerkcan, Erdinc (Reactor Centrum Nederland, Petten).

The p-method in reactor noise analysis is a technique of deriving reactor parameters for the experimentally determined p_k for detecting k neutrons in a certain time interval. Besides a direct analysis of p_o, the use of p_1 or p_{even} is shown to be feasible. Some difficulties met in the analysis of the experimental data are discussed. Some approximations of the p_k and the derivation of a multiple recursion process for the probability distribution of neutron counts are described. (12 references) (auth)

11332 (RCN-98, pp 291-9) THREEFOLD CORRELATIONS IN REACTOR NOISE. Dragt, J. B. (Reactor Centrum Nederland, Petten).

A simple theory is given on correlations between three neutrons detected in counters in a reactor. The threefold correlations are shown to be due to two different branching processes in the chains of fission events. In the dominating and easily measurable process only splitting of the fission chains into two branches is detected. In the other process triple splitting of the fission chain is involved. It appears that this process can provide new physical information; in particular reactor power and delayed neutron fraction can be found without the need for any other static measurement. A special third order moment is proposed for the measurement of this process. An experiment is described that has been performed at Petten, for the determination of this third order moment by means of an on-line computer. This experiment was not successful, however. The cause of the failure becomes clear when the higher modes of space and energy dependence are taken into account in the theory. This modal theory and its consequences are given. (auth)

11333 (RCN-98, pp 301-37) ENERGY CORRELATION OF NEUTRONS IN THE REACTOR AND THE PROBLEM OF EXPERIMENTAL DETERMINATION OF TWO-GROUP CONSTANTS. Bulavin, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii).

The stochastic process of neutron multiplication in the homogeneous bare reactor is investigated in two-group energy approximation on the basis of the "point" model. The division of the whole neutron spectrum into two energy regions is assumed to occur at the effective cadmium cut-off energy. The stochastic process of recording of neutrons of each energy group, using the appropriate detectors in the reactor, is studied as well. The analytical expressions for auto- and cross-correlation functions of the counting rate of the two detector types are obtained, which can be used for experimental determination of the two-group constants averaged over the neutron spectrum in a homogeneous multiplying medium. (20 references) (auth)

11334 (RCN-98, pp 555-77) ANALYSIS OF THE MEASUREMENT OF THE REACTIVITY CORRESPONDING TO THE STATIC FUNDAMENTAL MODE OF FAR SUBCRITICAL SYSTEMS. Vandeplas, P. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)).

The present work finds its origin in the difficulties encountered in the interpretation of experimental results of reactivity and prompt neutron decay measurements. The analysis of the different methods of measuring the reactivity by means of a periodical neutron source shows that the ratio of the integrals over a period of the prompt- and delayed-neutron densities is independent of the shape of the signal. This ratio which is a linear combination of the successive eigenvalues of the system, is equal to the ratio of the prompt- and delayed-neutron densities existing in the presence of a constant source. As shown by experiment and numerical analysis, this ratio is strongly space dependent. It is shown, analytically, that the contribution of space harmonics is seriously reduced in the integral over a well chosen volume of the system for the prompt- and the delayed-neutron density. By numerical analysis it is shown that the ratio of these integrals is practically equal to the reactivity corresponding to the static fundamental mode and quite independent of the source position. This method is compared to other methods used for the elimination of the harmonics contribution. By a suitable choice of the source position, the integral over a volume is reduced to a line integral; this is performed by a long detector requiring only one measurement. The optimisation of both the source position and the integral limits yielding the best values for the reactivity and prompt neutron decay constant can be achieved on purely experimental criteria. The experiments which will be performed in the future in relation to these methods are briefly described. (auth)

11335 NEUTRON SOURCE INVERSION LEVELS AND SOURCE-DROP TECHNIQUE FOR NEGATIVE REACTIVITY MEASUREMENTS. Pedretti, E. (CNEN, Rome). Nucl. Sci. Eng., 35: 149-52(Jan. 1969).

Techniques used for measuring the response of a zero power reactor to a step insertion of an extraneous neutron source are discussed. The source drop technique for reactivity measurements is described. Results of calibration of the control cylinders and single safety rod, using the source drop technique, are shown graphically. The working equations involving the reactivity are developed by introducing a source effect time into the usual one energy group space independent kinetic equations. 9 references. (M.L.S.)

11336 PERTURBATION METHODS IN NUCLEAR REACTORS FROM THE IMPORTANCE CONSERVATION PRINCIPLE. Gandini, A. (CNEN-CSN, Rome). Nucl. Sci. Eng., 35: 141-4(Jan. 1969).

Perturbation theory formulations of fast reactor criticality equations are derived. Equations are developed for steady state critical systems; effects of perturbations are then considered. The important conservation principle is applied to yield an expression for the adjoint flux. (M.L.S.)

11337 ANALYTICAL APPROACH TO CONTINUOUS REACTOR REFUELING. Yasukawa, S. (Japan Atomic Energy Research Inst., Tokyo). Nucl. Sci. Eng., 35: 1-13(Jan. 1969).

The analysis of the three-dimensional continuous refueling is approximated by the variational method. The axial flux distribution is treated by the trial function and expressed by the analytic expression, using the elliptic function. Introducing the perturbation technique in the flux expansion, the higher order cross-section expansion correction of the axial flux distribution is achieved by using the elliptic function as the base function in the flux expansion. It is shown that the group constants, averaged by the flux and its square, can be expressed by the simple rational function. As a special example, the nature of the eigenvalue under continuous unidirectional refueling is shown, and it is pointed out that some caution is required if the fuel burnup is evaluated by the reactivity-area method. (auth)

11338 THERMAL UTILIZATION IN NONCYLINDRICAL REACTOR CELLS CONTAINING A CYLINDRICAL FUEL ROD. Adir, Joel; Lamarsh, John R. (New York Univ., N. Y.). Nucl. Sci. Eng., 35: 14-26(Jan. 1969).

A new analytical method is presented for computing the thermal utilization of a noncylindrical unit cell containing a cylindrical fuel rod. No cylindrization of the cell is required. The boundary condition at the outer edge of the cell is formulated in terms of

a procedure that minimizes the square of the neutron current at a number of unspecified points along the edge. This leads to rapid convergence in computations of the thermal utilization, even with tightly packed lattices for which previous methods may not converge. The method is used to derive specific formulas for the thermal utilization using diffusion theory; the method of Amouyal, Benoist, and Horowitz; and, finally, the P_N method with anisotropic scattering. Sample computations using these models are also presented. (auth)

11339 PROPAGATION OF NEUTRON PULSES ACCORDING TO THE TIME DEPENDENT P_1-APPROXIMATION. Krainer, H.; Pucker, N. (Univ. of Graz). Atomkernenergie, 14: 11-16(Jan.-Feb. 1969).

The propagation of neutron pulses according to the consistent time dependent P_1-approximation of the one-velocity transport equation is investigated. It is outlined that for short times the solution depends sensitively on the boundary conditions used. This is demonstrated by comparing the results based on the logarithmic and the Marshak boundary condition respectively. The former turns out to be not very suited in the short-time region. 10 references. (auth)

11340 ANISOTROPIC DIFFUSION IN HETEROGENEOUS REACTORS. Saur, D. (Univ., Stuttgart). Atomkernenergie, 14: 22-4(Jan.-Feb. 1969).

For the purpose of first reactor design and calculations of criticality, static programs, based on the neutron diffusion equation, are used. One of the main problems is the calculation of a mean diffusion coefficient for a heterogeneous system. By means of the first flight theory the definitions in homogeneous media have been transferred to heterogeneous structures. These are compared with a generalized Benoist estimate in zeroth order. The problem has been solved in all one-dimensional geometries. The migration area method is the most interesting one because it takes account of absorption and sources immediately. Thus an application to multigroup theory is evident without later corrections necessary. This is not possible for methods weighting free transport paths. To demonstrate calculations some typical two region lattices in general cylindrical geometry are presented. The diffusion coefficients and anisotropy are shown as functions of the total cross section, the volume fraction void/cell, and the ratio absorption cross section/total cross section. Results are compared with Monte Carlo calculations. In the presented case (uniform flux distribution within the lattice) the generalized Benoist estimate in zeroth order and the migration area method do agree. But only the migration area method takes account of the absorption. (auth)

11341 ATTENUATION OF FAST NEUTRONS IN UNIFORM MEDIA. Copic, M. (Josef Stefan Nuclear Inst., Ljubljana, Yugoslavia). Atomkernenergie, 14: 8-10(Jan.-Feb. 1969).

The Fourier transform of the multigroup transport equation for fast neutrons, including anisotropic and inelastic scatterings, is solved for a plane source. The solution for the scalar flux due to the isotropic source is discussed more in details. The inverse Fourier transform is evaluated by the contour integration and has to be carried out numerically. (auth)

11342 CORRELATIONS BETWEEN THE RADIATION-CHEMICAL AND THERMOPHYSICAL PARAMETERS OF A CHEMO-NUCLEAR REACTOR. Demeshev, R. S.; Sidorov, A. M.; Tokarev, Yu. I. At. Energ. (USSR), 25: 235-6(Sept. 1968). (In Russian).

Fission fragments which contain about 84% of the fission energy are used to carry out radiation-chemical processes in the reactors. In order to ensure a large yield of fission fragments, the fuel elements of such reactors consist of foils of U alloy, and U-containing glass fiber system; powdered and thin-layer type fuel elements have also been proposed. The type of fuel element makes it difficult to maintain the required flow rate of the coolant through the core. This problem was investigated by studying the relation between the radiation-chemical processes and the thermal characteristics of the fuel elements. An expression was derived for calculating the absorbed dose, D, of the fission fragments on the basis of factors which affect D. The factors involved are the heat transfer intensity and the characteristics of the fuel, together with the parameters of the radiation-chemical reactions. It is recommended that a supplementary heat transfer agent be used to increase the absorbed dose; this supplementary coolant is designed to remove a large portion of the generated heat. Other possibilities are to divide the coolant stream in the core into two parts, or to remove the heat by means of a boiling heat transfer agent. (TTT)

11343 MULTIPLICATION METHOD OF NEGATIVE REACTIVITY MEASUREMENTS. Bouzyk, Jacek; Latek, Stanislaw; Suwalski, Witold (Inst. of Nuclear Research, Swierk, Poland). Nukleonika, 13: 1119-31(1968).

A reactivity measurement method based on the external neutron source multiplication is discussed. From the one-point reactor kinetic model, the formulae to be applied in the experiment are obtained. The derivation is repeated on the basis of the space-dependent approach. The experimental results illustrating the advantages and limitations of the method are presented. (auth)

11344 A SIMPLIFIED, INTEGRAL METHOD FOR NEUTRON THERMALIZATION IN A URANIUM-D_2O LATTICE WITH PLUTONIUM. PART I. Bonalumi, R.; Palazzi, F.; Pierini, G. (Centro Informazioni Studi Esperienze, Milan). Energ. Nucl. (Milan), 16: 25-35(Jan. 1969).

A simplified model is described for the calculation of two-group effective cross-sections in a uranium-D_2O lattice where the fuel may contain Pu isotopes and cooling is provided by a high temperature hydrogeneous coolant. Spectrum in the fuel region is evaluated analytically by assuming a Westcott type spectrum in the moderator, and by a separate treatment of the fuel induced distortions in its Maxwellian and epithermal components. Main features of the method are: the use of first collision probabilities in the fuel element (with parabolic source) and diffusion theory in the moderator; and the use of integral, though simplified, scattering kernels in the fuel region to describe both slowing-down and thermalization. The thermal spectrum in the fuel is obtained analytically, and the physical meaning of the result is discussed. (auth)

Experimental Applications

11345 (KAPL-M-6940) RECAP-D: A DEPLETION AND EDIT CODE FOR RECAP-4C MONTE CARLO CALCULATIONS. Venerus, Ernest R. (Knolls Atomic Power Lab., Schenectady, N. Y.). July 1968. Contract W-31-109-eng-52. 17p. Dep. CFSTI.

RECAP-D is a depletion code which has been automated to read a tape generated by a RECAP-4C Monte Carlo calculation, edit absorption rates and deplete various isotopes based on an input chain description. Depleted number densities are provided in the form of punched card output which can be used directly in the Monte Carlo calculation of the next depletion step. In Fortran IV. (auth)

11346 (RCN-98, pp 91-6) THE EXPERIMENTAL SET-UP FOR THE PULSED NEUTRON MEASUREMENT TECHNIQUE. Oei, T. D. (Reactor Centrum Nederland, Petten).

The experimental set-up of the equipment used for the pulsed-neutron experiment for reactivity measurements in multiplying media is described. The set-up consists of a pulsed-neutron source, amplifiers of the counting channels, a time analyzer, and a "buffer register." The buffer register in aid to the 400-channel time analyzer makes it possible to measure the flux response of the reactor at maximum four different detector locations simultaneously. (auth)

11347 (RCN-98, pp 523-54) PULSED AND MODULATED NEUTRON SOURCE TECHNIQUES AND THEIR INTERRELATION. Rotter, W.; Maene, N.; Delrue, R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). Societe Belge pour l'Industrie Nucleaire, Brussels).

The measurements described are part of a general experimental effort to improve the reliability of measurements in highly subcritical lattices. These include prompt neutron lifetime and reactivity measurements. It is shown that the three common methods for measuring local reactivities have the same space dependence if the three experiments are performed under exactly similar conditions. This can be expected on theoretical grounds. Defining a transfer function for prompt neutrons, its space dependence can be eliminated to a high degree if only the harmonic free part of the pulse response is used for the analysis. The decay constant can be determined from this reduced prompt transfer function. The sensitivity of this method on systematic deviations from the pure exponential decay offers some valuable checks in the interpretation of pulsed neutron experiments. Also the delayed neutron tail can be determined with high accuracy. The elimination of the spatial dependence in the transfer functions results in a correction factor for the time integral of the prompt neutron response. (auth)

11348 ON THE USE OF DYNAMIC COORDINATE FUNCTIONS IN BURN-UP-SYNTHESIS-CALCULATIONS. Nathschlaeger, P.; Wagner, J. (Institut fuer Reaktortechnik, Seibersdorf, Austria). Atomkernenergie, 14: 5-7(Jan.-Feb. 1969).

A dynamic coordinate method is used to optimize computer time for burnup synthesis calculations. The Newton-Coates quadrature formulae are used to compute the matrix elements in the burnup

synthesis variational codes; eigenvalues are determined by the vector iteration method. Error functions are given for assessing the accuracy of the calculations. (M.L.S.)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 9611, 9612, 9623, 9792, 9808, 9813, 9815, 10155, 10162, 10176, 10177, 10195, 10196, 10198, 10245–10247, 10251–10253, 10256, 10262, 10275, 10298, 10299, 11153, and 11154.

11349 (AHSB(S)Handbook-5(Pt.3)) HANDBOOK OF EXPERIMENTAL CRITICALITY DATA. PART III. CHAPTERS 7 TO 10. Abbey, F. (comp.) (United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch). 1968. 114p. Dep. CFSTI. UK.

Chapters 7 to 10 of the Handbook of Experimental Criticality Data are presented. Topics discussed include: single ^{233}U cores of various configuration; interacting arrays of ^{235}U for various enrichments and compositions; and ^{238}U lattices and Pu lattices with varying moderators. (D.C.C.)

11350 (ANL-7388) IRRADIATION BEHAVIOR OF HIGH-BURNUP URANIUM–PLUTONIUM ALLOY PROTOTYPE FUEL ELEMENTS. Beck, W. N.; Fousek, R. J.; Kittel, J. H. (Argonne National Lab., Ill.). May 1968. Contract W-31-109-eng-38. 47p. Dep. CFSTI.

Alloys containing both uranium and plutonium are being developed as fuels for fast breeder reactors. The alloys selected for the study described were U–Pu–Fs, U–Pu–Zr, and U–Pu–Ti. The irradiation behavior of the U–20 wt % Pu–10 wt % Fs alloy has been evaluated previously in the form of prototype EBR-II fuel elements. Additional work on this alloy and results obtained from studies on more advanced fuel alloys are reported. The irradiation studies were performed with cylindrical fuel pins sodium-bonded to tubular cladding. The cladding materials investigated included refractory alloys as well as iron- and nickel-base alloys. The investigations studied variations in the (1) plutonium concentration in the fuel pin, (2) cladding wall thickness, (3) irradiation temperature, (4) vented plenums, (5) type of cladding materials, and (6) type of fuel materials (solid fuel, disc-type fuel, and sodium-impregnated powder fuel). The investigations determined fission-gas release from the fuel as a factor of volume expansion, and maximum attainable fuel burnups. Fuel-element design was the variable that resulted in the most significant improvement in the irradiation performance of the fuel; sufficient space for annular fuel swelling was alloted to accommodate solid fission products and to enable a significant fraction of the fission gas to be released from the fuel alloy. The most promising alloy tested for fast breeder reactors was the U–Pu–Zr composition, which contained approximately 15 wt % plutonium and 10–15 wt % zirconium. Successful irradiations were performed with this alloy at maximum cladding temperatures of 655°C and burnups of 12.5 at. %. (auth)

11351 (BNWL-919, pp 5.1-17) NUCLEAR CERAMICS. Nightingale, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A description of microstructure and transmission electron microscopy studies of nuclear sintered PuO_2-UO_2 is presented. Mechanical properties of UO_2 and PuO_2-UO_2 fuels are evaluated. The high-temperature creep behavior of UO_2 and PuO_2-UO_2 is analyzed. The effects of stoichiometry on thermal diffusivity and conductivity of PuO_2-UO_2 are discussed. The effects of thermal cycles on electrical resistivity of UN are evaluated. The effects of neutron radiation on melting points of UO_2 samples are described. (25 references are included) (D.C.C.)

11352 (BNWL-919, pp 8.1-3) METALLIC FUELS. Tverberg, J. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The fabrication of a rod-shaped pellet-type metallic uranium fuel is described. The fuel is clad with Ozhenite. The fuel consists of Al–C–Fe–Si–U. (D.C.C.)

11353 (BNWL-919, pp 9.1-13) BASIC SWELLING STUDIES. Tverberg, J. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The neutron radiation effects on the swelling of U_3Si, Pu–U, Th–U, and uranium metal are evaluated. (D.C.C.)

11354 (KAPL-3453) LITERATURE SURVEY ON IN-PILE MECHANICAL PROPERTIES: TESTING AND THEORY. Miller, S. H.; Moyar, G. J.; Troller, C. E. (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 15, 1968. Contract W-31-109-eng-52. 40p. Dep. CFSTI.

A survey of unclassified literature published from 1962 to 1968 on the in-pile mechanical properties of reactor structural and fuel materials was conducted. Information on test equipment, experimental results, and theory were considered. The current review includes a state of the art summary of in-reactor Zircaloy properties, a tabular summary of information given in the cited literature, and a listing of the cited references with abstracts. 94 references. (auth)

11355 (WAPD-T-2067) FISSION GAS BUBBLES IN FRACTURED UO_2 CHIPS. Katz, O. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). May 1968. Contract AT-11-1-GEN-14. 4p. (CONF-680905-4). Dep. CFSTI.

From 26th Annual Meeting of the Electron Microscopy Society of America, New Orleans, La.

The swelling of irradiated UO_2 is analyzed. The bubble characteristics observed by transmission electron microscopy in high density UO_2 irradiated between 3.8 and 24.9×10^{20} fissions/cm^3 at temperatures below 870°C are described. The size and distribution of the fission gas bubbles in the chips were analyzed before and after in-microscope heating at 1200 to 1400°C for 5 minutes. (D.C.C.)

11356 WATER TREATMENT FOR REACTORS. Ryan, L. F.; Brown, R. M. Power Eng., 73: 36-9(Jan. 1969).

The use of powdered anion and cation resins and anion and cation bead resins as ion exchange materials for nuclear reactor water systems is described. Economic and performance comparisons are made for the powder and bead resins. Examples of water systems using the resin treatment techniques are presented. (D.C.C.)

11357 TEMPERATURE MEASUREMENT OF FUEL ELEMENT CLADS WITH THERMOCOUPLES. Poncins, Andre. Energ. Nucl. (Paris), 10: 381-8(Oct. 1968). (In French).

Improvement in the performance of a nuclear reactor depends largely on knowledge of the characteristics of its components. Among these, the temperature of the fuel element casings is particularly important, and hard to measure. A new technique developed by the Atomic Division of SNECMA allows this temperature to be measured in safety. The method has already led to many achievements and in particular has made very thorough testing of reactors possible. (auth)

11358 STRUCTURE OF A NUCLEAR FUEL ELEMENT. Ishida, Ryuichi (to Sumitomo Electric Industries Ltd.). Japanese Patent 1968-21272. Sept. 6, 1968. Filed May 28, 1965.

By the method proposed, the distribution of coolant-water flow rate and amount can be made uniform in a fuel element which contains axial fuel plates. Axial fuel plates are arranged in a fuel element one upon another; coolant water enters the element from one end and leaves it at the other end. Where coolant enters, the end of axial fuel plates is brought closer to the coolant inlet as the incoming coolant flow is higher. (NSA of Japan)

11359 NUCLEAR FUEL ELEMENT. Stohr, Jacques (to Commissariat a l'Energie Atomique). British Patent 1,139,990. Jan. 15, 1969. Priority date Jan. 25, 1967, France.

GRAPHITE—fuel element core of, fabrication for metal-clad uranium oxide (UO_2) or plutonium oxide (PuO_2) of
PLUTONIUM OXIDES PuO_2—fabrication of, fuel elements of description of metal-clad graphite-centered
REACTOR FUEL ELEMENTS—fabrication of metal-clad graphite-centered uranium oxide (UO_2) or plutonium oxide (PuO_2), description of
URANIUM OXIDES UO_2—fabrication of, fuel elements of, description of metal-clad graphite-centered (D.C.C.)

11360 METHOD FOR START UP OF A NUCLEAR REACTOR UTILIZING A DIGITAL COMPUTER. Cohn, Charles E. (to United States Atomic Energy Commission). U. S. Patent 3,424,653. Jan. 28, 1969.

A method of control for the start-up of a nuclear reactor employing a digital computer is described. The computer is employed in the feedback loop by sampling the reactor flux. A step adjustment is made of the reactor control rod in response to the difference between a computed desired flux value and an extrapolated flux value on the logarithmic slope between the two most recent flux samples. Adjustment of the deadband of the control system is performed, as equilibrium is approached, to maintain the amount of rod jitter within predetermined limits. (auth)

11361 BACK-UP REACTOR SCRAM DEVICE. Henmi, Yoshinori (to Hitachi Ltd.). Japanese Patent 1968-22788. Sept. 25, 1968. Filed Jan. 20, 1965.

Liquid poison is used as a scram and is injected into a coolant system by means of the gas pressure. As the pressure is decreased during the injection, the amount of poison injection is not decreased. The device consists of the following: a tank containing a liquid poison and pressurized by a gas in the tank; a pipe running from the tank bottom to a coolant system; and a pipe running from the upper gas portion of the tank to a point of the poison pipe halfway over the pipe length with a valve in the gas pipe which opens more as the gas pressure in the tank is decreased. (NSA of Japan)

11362 REACTOR CONTROL ROD IN THE FORM OF A CATERPILLAR. Nakamura, Shoichiro (to Hitachi Ltd.). Japanese Patent 1968-20225. Aug. 30, 1968. Filed Aug. 16, 1963.

Using the caterpillar control rod proposed, the neutron flux distribution in a nuclear reactor can be greatly improved. The control rod is formed by arranging and connecting multiple control elements in the shape of a catepillar; the caterpillar is run vertically through the reactor core. The control rod sections are arranged in the order of the magnitudes of neutron absorption potential. (NSA of Japan)

11363 FUEL ELEMENT FOR A NUCLEAR REACTOR. Ishikawa, Kiyoshi (to Hitachi Ltd.). Japanese Patent 1968-20958. Sept. 7, 1968. Filed Mar. 11, 1965.

Using the fuel elements proposed, the economy and safety of a nuclear reactor can be increased considerably; the increase in internal pressure is reduced and the localization in power density prevented. In assembling a fuel rod in the fuel element, solid and hollow fuel pellets of a sintered non-metallic material are piled alternately one upon the other in its cladding. (NSA of Japan)

11364 NUCLEAR FUEL ELEMENT. Morita, Takahiro (to Hitachi Ltd.). Japanese Patent 1968-20221. Aug. 30, 1968. Filed Feb. 27, 1964.

By the method proposed, neutron absorbing substance can be excluded to a large extent in a fuel element. Tubes, made of a low neutron absorbing material and filled with a substance of extremely small neutron absorption, are inserted into the space formed by fuel rods in the element container. (NSA of Japan)

11365 REACTOR CONTROL ROD. Ebata, Takeo (to Hitachi Ltd.). Japanese Patent 1968-20228. Aug. 30, 1968. Filed Feb. 14, 1966.

In BWR's for example, a control rod is introduced into the reactor from the bottom by its driving rod. By the method proposed, the dropping speed of the control rod in the case of breakage of the driving rod can be reduced considerably. Plates are fixed at their upper end to the surface of the driving rod. They unfold outward with the fixed end as the pivot. When dropping in an accident by gravitational force, the unfolded plates reduce the dropping speed by the resistance against the surrounding fluid. (NSA of Japan)

11366 DEVICE FOR DRIVING A REACTOR CONTROL ROD. Mikami, Takao (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1968-20226. Aug. 30, 1968. Filed Aug. 21, 1964.

The control-rod driving device proposed is useful for boiling-water reactors in which control rods are inserted from the bottom. It consists of the following: the first cylinder moving vertically on top of which a control rod is supported with multiple hollows being made on the inner surface; the second cylinder fixed co-axially with the first cylinder forms a path for a pressure liquid; a cylindrical member moving in the upper part of the second cylinder which supports the first cylinder by its surface claws engaging with the hollows; a plate opposed to the claws from above over the upper end of the second cylinder; springs connecting the plate and cylindrical member; and a device which permits the up and down movement of the first cylinder. (NSA of Japan)

11367 SYSTEM FOR BREAKING A MOVING MASS. Isidore, Gabriel; Jug, Victor; Maupin, Robert; Vial, Bernard (to Commissariat a l'Energie Atomique). British Patent 1,140,753. Jan. 22, 1969. Priority date Sept. 28, 1965, France.

BRAKES— reactor control element, description of dual-section multiple expanding annular disc-type rubbing

REACTOR CONTROL ELEMENTS— brakes for, description of dual-section multiple expanding annular disc-type rubbing (D.C.C.)

11368 METHOD OF FLUX SEPARATION IN NUCLEAR REACTORS AND STRUCTURE THEREFOR. Klahr, Carl N. British Patent 1,138,288. Dec. 27, 1968. Filed Mar. 15, 1966.

Means are described for the subjection of adjacent fuel regions of nuclear reactors to thermal neutron fluxes of substantially different magnitudes. This avoids the disadvantages of surrounding appropriate regions with strong neutron absorbing materials. A flux separator, or internal reflector, which need not be a neutron absorbed, is suitably positioned between adjacent regions of appropriate composition. A decoupling of the fluxes and the power levels in the adjacent regions is accomplished by reflection of neutrons rather than by neutron absorption. (UK)

11369 FUEL HANDLING SYSTEMS ASSOCIATED WITH A NUCLEAR REACTOR. Burton, John Cornelius; Long, Frank Charles; Walker, Desmond John (to English Electric Co., Ltd.). U. S. Patent 3,416,996. Dec. 17, 1968. Priority date Apr. 1, 1966, Great Britain.

In a combined dry-store and fuel-handling facility for a nuclear reactor, a carousel is rotatable on a vertical axis so that its tubes connect with: a fueling machine above the facility; means below the carousel for cutting up used fuel-stringer tie-rods for disposal to a closed void; a space below the carousel containing means for removing spent fuel elements and means for loading new fuel elements and/or tie-rods into the carousel; and handling means above the carousel for moving fuel element components within the facility. (Offic. Gaz.)

11370 ROD POSITION INDICATOR. (to Borg-Warner Corp.). British Patent 1,140,552. Jan. 22, 1969. Priority date Sept. 1, 1966, United States.

REACTOR CONTROL ELEMENTS— position indicator for, description of rod-actuated magnet with multiple vertically-spaced magnetically-operated rod switches in (D.C.C.)

11371 SIMULATOR FOR TRAINING OPERATOR OF NUCLEAR POWER STATION. Matsuda, Hiroyoshi (Japan Atomic Power Co., Tokyo). Genshiryoku Kogyo, 14: No. 8, 41-4(Aug. 1968). (In Japanese).

The reactor simulator, which is an analog computer, employed in the JAPC is capable of training in the operation of both natural-U gas-cooled reactors and light-water reactors. The training in JAPC with this simulator is described in the following: an outline of the facility; simulator for a natural-U gas-cooled power station (extent of its simulation, analog circuits for training purposes, operation console, and methods of training); and, simulation of a light-water power station. (NSA of Japan)

GENERAL

11372 (AED-AB-1968-12) INFORMATION ON NUCLEAR SCIENCE AND TECHNOLOGY. Abstract Journal. (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Dec. 1968. 219p. (In German and English).

11373 (AERE-R-5875) ANODIC OXIDATION OF SILICON. Wilkins, M. A. (Atomic Energy Research Establishment, Harwell (England)). Aug. 1968. 15p. Dep. CFSTI. UK 3s.

In order to measure concentration profiles of ions implanted into thin silicon wafers it was necessary to remove thin and even layers from the irradiated surface. The method adopted was to oxidize the silicon surface anodically and then remove the oxide with dilute HF. The effects of current density and temperature on the oxidation were investigated, and the rate of formation of the oxide was determined. It was concluded that the method is very satisfactory. The possibility of obtaining information on the mode of electrical conduction through the oxide was also investigated. The efficiency of anodic oxidation for Si is very low, and most of the conduction must be electronic. It has been suggested that the current is due to injection of electrons by "tunneling" from the electrolyte into the oxide conduction band. By contrast, thermally grown SiO_2 shows very little conduction, and there are also physical differences between the anodic and thermally grown oxides. The density and refractive index are lower for the anodic oxide, and solubility in HF is about a hundred times higher than for the thermally grown oxides. In view of these differences an examination of the anodically formed oxides by optical and electron microscope techniques was undertaken. (UK)

11374 (BNWL-715-3, pp 184-90) SOME ENVIRONMENTAL CONSEQUENCES OF SHADING IN SHRUB COMMUNITIES. Hinds, W. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The thermal environment around shrubs was studied to determine the effects of shade on soil and air. Soil temperature measurements were made near a multi-stemmed desert-steppe shrub. The results showed that shrubs induce a wide variety of alterations in their immediate environment and may provide a community-scale alteration in the earth-air energy exchange mechanism. (L.C.L.)

11375 (CEA-R-3596) THE SPRINT/1 LANGUAGE FOR THE DYNAMIC EVALUATION OF THE MATHEMATIC FORMULAS BY DIRECT COMMUNICATION WITH A COMPUTER. Cavadia, Izvoras Cristian (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sept. 1968. 403p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Orsay, France. computers; physics 09B, 20

The SPRINT language system, which is intended for real-time use of computers and can be used by persons without special training in programming, is described with emphasis of the SPRINT/1 version for the CAE 90/40 computer. (D.C.W.)

11376 (COO-1684-6) CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS, FLASH HEATING OR FLASH PHOTOLYSIS. Technical Progress Report, February 1-December 31, 1968. Kay, Jack G. (Toledo Univ., Ohio). Contract AT(11-1)-1684. 6p. Dep. CFSTI.

It was found that the flash heating pretreatment of γ-alumina has no significant effect on its catalytic activity. Photoluminescence experiments were carried out on $KMnO_4$ crystals at liquid nitrogen temperatures. Vibrational analysis for the electronic absorption spectrum of TiF was completed. A high-resolution spectrum of vaporized MnO was obtained using ^{18}O labeling. (M.C.G.)

11377 (KAPL-M-6734(A)) ADDENDUM TO FITS TO THERMODYNAMIC PROPERTIES OF WATER. Jordan, W. B. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 28, 1968. Contract W-31-109-eng-52. 7p. Dep. CFSTI.

Algebraic fits which had previously been made to the thermodynamic properties of water are compared with the newly released official ASME calculations. The comparison shows the fits are satisfactory. A fit to the viscosity of saturated steam is presented. (auth)

11378 (KAPL-M-6949(Rev.1)) BEAVER: AN INTEGRATION AND/OR DIFFERENTIATION PROGRAM. Poteralski, Daniel C. (Knolls Atomic Power Lab., Schenectady, N. Y.). July 31, 1968. Contract W-31-109-eng-52. 11p. Dep. CFSTI.

11379 (LA-3983) USE OF COLLINEATIONS FOR INTERPOLATION ON AN IRREGULAR MESH. Lewis, H. Ralph (Los Alamos Scientific Lab., N. Mex.). Feb. 1968. Contract W-7405-eng-36. 13p. Dep.

A method is described for using collineations for interpolation on an irregular mesh whose elementary cells are quadrilaterals and whose mesh points are ordered in a way topologically equivalent to the ordering of the points of a rectangular mesh. First the irregular mesh is transformed to a rectangular mesh, and then interpolation is performed on the rectangular mesh. Listings of two computer programs that implement the method are given with examples. One of the programs uses bicubic spline interpolation on the rectangular mesh, and the other uses bilinear interpolation. (auth)

11380 (LA-4031) CADMIUM ACTIVITY IN ITS ALLOYS WITH A SMALL AMOUNT OF GOLD FROM THE EMF OF STIRRED H CELLS. Houseman, Barton L.; Elliott, Guy R. B. (Los Alamos Scientific Lab., N. Mex.). Apr. 1967. Contract W-7405-eng-36. 12p. Dep. CFSTI.

Stirred H-cell electromotive force measurements on solvent concentration cells of the type, W-Cd, $Au_{(liq\ soln)}$ /Cd $I_{2(l)}$/$Cd_{(l)}$-W, were made with high precision using compositions from 0.001 to 0.021 mole fraction of gold at 673, 742, and 773°K. The results at each temperature, except for narrow transition regions, may be described by two linear equations. All equations are of the form $a_{Cd} = c_1 - k_1 N_{Au}$, which was previously shown to hold for other systems. Solubility and anodic current efficiency measurements are reported. (auth)

11381 (NP-17632(Vol.2)) INFORMATION ON NUCLEAR SCIENCE AND TECHNOLOGY. VOLUME II. ANNUAL INDEX. Subjects. (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1967. 479p. (In English and German). Dep.

A computer program (BEAVER) which integrates and differentiates the general polynomial equation $A_0 + A_1x + A_2x^2 + \ldots + A_nx^n$ and the exponential equation Ae^{bx} is described. (B.G.D.)

11382 (NP-17734) ANNUAL REPORT, 1967. Year Ended 31st December 1967. (Australian Inst. of Nuclear Science and Engineering, Lower Hutt). 25p. Dep.

The member organizations, AINSE council, office bearers, executive committee, specialist committees, and staff are listed. Finances, activities, visits and attachments to Lucas Heights, research and training grants, AINSE fellowships and studentships, and AINSE conferences are discussed. Also, titles of projects and publications for 1967 arising from AINSE projects are listed. (W.H.K.)

11383 (SC-RR-68-636) A COMPUTER TECHNIQUE TO DETERMINE THE SEEBECK COEFFICIENT OF THERMOELECTRIC MATERIALS IN A CHANGING TEMPERATURE GRADIENT. White, Richard M. (Sandia Labs., Albuquerque, N. Mex.). Oct. 1968. 58p. Dep.

A computer technique is presented which determines the Seebeck coefficient of thermoelectric materials in a changing temperature gradient. A mathematical description of the technique is presented, and typical test data are analyzed. The limitations of the technique and its range of application are determined. (auth)

11384 (SC-RR-68-838) PREDICTION OF THE HAZARDS FROM THE RANDOM IMPACT OF METEORITES ON THE EARTH'S SURFACE. Blake, V. E. (Sandia Labs., Albuquerque, N. Mex.). Dec. 1968. 19p. Dep. CFSTI.

The probability of a person being injured of killed by a meteorite is estimated. It is concluded that there is a distinct possibility that someone will be seriously injured, possibly killed, by a meteorite fall within the next 50 years. In addition, there is a not insignificant probability that a large meteorite will impact a populated area and kill a number of people. (auth)

11385 (STI/DOC-11(Vol.6)(No.3)) LIST OF BIBLIOGRAPHIES ON NUCLEAR ENERGY. (International Atomic Energy Agency, Vienna (Austria)). Dec. 1968. 39p.

One hundred and forty eight bibliographies on chemistry; earth sciences; engineering; instrumentation; life sciences; metals, ceramics, and other materials; general physics; high energy physics; nuclear physics; reactor technology and other miscellaneous topics are listed. Author and corporate author indexes are included. (B.G.D.)

11386 (TID-3749) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period September-October 1968. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 9p. Dep. CFSTI.

11387 (TID-24834) DESIGN OF INLET DISTRIBUTORS FOR CHROMATOGRAPHIC COLUMNS. Musser, William Neil (Case Western Reserve Univ., Cleveland, Ohio. Div. of Chemical Engineering Science). Aug. 1968. 235p. Dep. CFSTI.

The design of inlet distributors for large scale chromatographs was considered. A number of techniques for obtaining a uniform distribution of the solute pulse over the bed cross section were investigated experimentally. Velocity profiles were measured for superficial velocities from 1 to 10 cm/sec using a thermistor anemometer technique. The velocity distribution was found to be poor for packed inlet cones. The use of high-solidity wire gauzes was found to be an attractive possibility. In inlet cones of high divergence, a solid disc placed near the inlet further improved the distribution. Dispersion in these inlets was estimated using certain modeling techniques. The reduction of the volume of the inlet device was found to be a more important design objective than the reduction of the second moment of the residence time distribution. Inlet cones of high divergence packed to within at least 70% to 80% of their volume should have dispersions of less than 0.5 seconds for superficial bed velocities from 1 to 10 cm/sec. Cones of high divergence equipped with multiple wire gauzes should have dispersions of less than 3 seconds over the same velocity range and may prove adequate for many applications. Finally, an inlet distributor was developed, which has good distribution and very low dispersion. The velocity profile was flat to ±3% at a superficial bed velocity of 10 cm/sec and less than ±15% at a velocity of 1 cm/sec. The dispersion was estimated to be as low as that for the packed inlet. Further the dispersion is expected to be nearly independent of column diameter so that the performance of this design in larger diameter columns should be better in all respects than that of the alternative designs considered. (auth)

11388 (UCRL-50422) ADIABATIC EXPANSION OF HIGH EXPLOSIVE DETONATION PRODUCTS. Lee, E. L.; Hornig, H. C.; Kury, J. W. (California Univ., Livermore. Lawrence Radiation Lab.). May 2, 1968. Contract W-7405-eng-48. 38p. Dep. CFSTI.

A relatively simple pressure, volume, energy (PVE) equation of state was developed to describe the adiabatic expansion of detonation products. Specific equations for ten explosives were determined using detonation velocity and pressure data and results from metal acceleration experiments. The thermodynamic and hydrodynamic requirements placed on this equation of state are discussed and a comparison of calculation and experimental results is presented. (auth)

11389 (UCRL-50516) THE DIFFUSION OF IRON IN α-Fe-Si ALLOYS. Lai, D. Y. F.; Borg, R. J. (California Univ., Livermore. Lawrence Radiation Lab.). Oct. 3, 1968. 7p. Dep. CFSTI.

The diffusion coefficient of iron was determined by a tracer method in α-Fe-Si alloys. The composition dependence of activation energy and diffusion was measured over almost the entire phase field. (auth)

11390 MEMORY EXTENSION INTERFACE (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1805). 7 drawings.

An interface is described which is used to link a PDP-6 computer to a core memory unit containing 16,384 words of 36 bit storage. Binary data and control information transfer over a 72-line memory bus to one of 6 ports in the memory interface. Five remaining ports are available for use by direct memory access. (TSS)

11391 EXCHANGE OF NOTES BETWEEN THE GOVERNMENT OF THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND AND THE GOVERNMENT OF PORTUGAL PROLONGING THE AGREEMENT FOR CO-OPERATION IN THE PEACEFUL USES OF ATOMIC ENERGY SIGNED AT LONDON ON 18th JULY 1958, LISBON 16th JULY 1968. Cmnd. 3812 (Treaty Series No. 101, (1968)). London, Her Majesty's Stationery Office, 1968. 3p. 9d.

11392 LOGIC, METHODOLOGY, AND PHILOSOPHY OF SCIENCE. III. Proceedings of the Third International Congress held in Amsterdam, August 25-September 2, 1967. van Rootselaar, B.; Staal, J. F. (eds). Studies in Logic and the Foundations of Mathematics. Amsterdam, North-Holland Publishing Company, 1968. 565p. $22.50. (CONF-670826).

The proceedings of the Third International Congress for Logic, Methodology, and Philosophy of Science are presented. The topics covered were mathematical logic; foundations of mathematical theories; automata and programming languages; philosophy of logic and mathematics; general problems of methodology and philosophy of science; methodology and philosophy of physical sciences; methodology and philosophy of biological sciences; methodology and philosophy of psychological sciences; methodology and philosophy of social sciences; methodology and philosophy of linguistics; and history of logic, methodology and philosophy of science. (B.G.D.)

11393 ON THE REVISION OF THE U.S.-JAPAN AND THE BRITAIN-JAPAN ATOMIC AGREEMENT. Haginoya, Toru. Shin Kinzoku Kogyo, 13: No. 6, 141-4(June 1968). (In Japanese).

The US-Japan and the Britain-Japan Atomic Agreements, concluded originally in 1958, were revised and ratified by the Diet in May 1968. Both the Agreements, necessary in the promotion of Japan's atomic research and development, have served the purpose of acquiring enriched uranium for research reactors and ensuring the supply of natural uranium for the JAPC power station. With the recent revision, the two Agreements will be effective for thirty years. Descriptions include revisions of the main points in the US-Japan Agreement, US policy for the supply of nuclear fuels, and uranium demands in the United States. (NSA of Japan)

11394 ANNUAL REVIEW OF NUCLEAR SCIENCE. VOLUME 18. Segre, Emilio; Grover, J. Robb; Noyes, H. Pierre (eds.). Palo Alto, Calif., Annual Reviews, Inc., 1968. 559p. $8.50.

For abstracts of individual papers see: 10106, 10802, 11017, 11063, and 11068-11070.